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OHIO RIVER DRAINAGE BASIN. A COOPERATIVE STATE-FEDERAL REPORT ON WATER POLLUTION

Public Health Service
Cincinnati, Ohio

1951

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For Clean Water—"One River, One Plan"

Ohio River

DRAINAGE BASIN

A COOPERATIVE STATE-FEDERAL REPORT ON WATER POLLUTION

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SUMMARY REPORT ON WATER POLLUTION

Ohio River Drainage Basin

Prepared by

FEDERAL SECURITY AGENCY
Public Health Service
Division of Water Pollution Control
Ohio and Tennessee Drainage Basins Office

1951

On the basis of information
supplied by:

Illinois Sanitary Water Board
Indiana Stream Pollution Control Board
Kentucky Water Pollution Control Commission
Maryland Water Pollution Control Commission
New York State Department of Health
North Carolina State Board of Health
Ohio River Valley Water Sanitation Commission
Ohio State Department of Health
Pennsylvania Sanitary Water Board:
State Department of Health
Tennessee Stream Pollution Control Board
Virginia State Water Control Board
West Virginia State Water Commission

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Details of illustrations in
this document may be better
studied on microfiche.

I

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*Each Sub-Basin Report includes Tables A through H, and "Table I - Project List - Municipalities and Industries Requiring Improvements for Abatement of Pollution."

INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June of 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies, and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

In developing these programs, due regard must be given to improvements necessary to conserve the Nation's waters for public water supplies, propagation of fish and aquatic life, recreational purposes, agricultural, industrial, and other legitimate uses.

Recognizing the fact that full technical information was not available to permit the development of such comprehensive programs immediately for most of the Nation's waters, the Public Health Service envisioned the development of these programs in two general phases. The first phase contemplated the development of a series of reports, consistent with presently available data, which would: provide a reference point for measuring progress; provide a guide to needed additional data; provide a basis for the logical development of comprehensive programs; provide a basis for approval of loans to States, interstate agencies and municipalities at such time as the Congress made available funds for this purpose; and serve to inform the public on the problem of water pollution and set forth suggestions for pollution control.

The collection of available data as of July 1, 1950, has been completed under the first phase of the program. Such data have been assembled with the cooperation of State and interstate water pollution control agencies. Through these agencies additional data have been obtained from other State officials, county and city officials and representatives of industry. Federal agencies also have been of great assistance. In order to make this information available at the earliest possible moment, these data are being presented in 15 summary-type reports covering the United States by major drainage basins. This report on the Ohio River Basin is one of that series.

These summary reports present information about the ways our water resources are used, the pollution going into our water resources and the resulting damages, the benefits which may result from pollution prevention and abatement, the pollution prevention measures now in effect, and those required.

They are prepared in two parts. Part one considers the water pollution problems of the basin as a whole. Part two presents briefly the data for each of the several sub-basins of the major basin, including a list of projects now known to be needed for water pollution control.

Since the summary reports are based on data which are now readily available, these reports do not discuss or evaluate the most advantageous water uses as they are related to pollution control. Such considerations will be included as a part of the comprehensive water pollution control programs.

The deficiencies in data and the gaps in information indicated in these summary reports are as significant as the presentation of available facts and statistics. They indicate the work which still needs to be accomplished by water pollution control authorities for the preparation of comprehensive programs.

Data and knowledge now available are sufficient, however, to permit the immediate solution of many of the pollution problems within the Ohio Basin without awaiting the results of additional surveys and studies. The tabulations of pollution abatement projects which are included in part two of this summary report represent presently known needs. However, future studies and evaluations may result in some changes in the estimation of requirements.

A sincere effort has been made by all who contributed to this report to present a fair picture of the complex water pollution problems in the Ohio Basin and to present reasonable conclusions and recommendations. It is our hope that this report, as a step in the cooperative development of an ultimate comprehensive pollution control program, will help in safeguarding the water resources of the Ohio Basin.

Leonard A. Scheele

Surgeon General

ACKNOWLEDGMENTS

The Public Health Service wishes to acknowledge the cooperation and assistance of those agencies and individuals that have contributed to the preparation of this report.

The water pollution control agencies of the States in the basin, including the New York State Department of Health, Pennsylvania Sanitary Water Board, State Department of Health, West Virginia State Water Commission, Ohio State Department of Health, Virginia State Water Control Board, Kentucky Water Pollution Control Commission, Indiana Stream Pollution Control Board, Illinois Sanitary Water Board, Maryland Water Pollution Control Commission, North Carolina State Board of Health, Tennessee Stream Pollution Control Board, and the Ohio River Valley Water Sanitation Commission, have furnished the data from which the various tables were prepared and other data and information contained in the narrative statements. These agencies have also reviewed the preliminary draft of the report and have offered valuable comments which have been incorporated in the report.

Federal agencies from which assistance or data were obtained include the Corps of Engineers, Department of the Army, and the Fish and Wildlife Service and Geological Survey, Department of the Interior.

Recognition is also given to use of basic information contained in the Ohio River Pollution Control Survey, prepared jointly by the Corps of Engineers and the Public Health Service and published as House Document No. 266, 78th Congress, 1st Session.

Finally, there is acknowledged the assistance of other State agencies and individuals interested in water resources development and conservation, that have contributed information through many sources.

SUMMARY

The Ohio River Basin has a total drainage area of about 163,000 square miles exclusive of the Tennessee River Basin and drains part of the States of New York, Pennsylvania, North Carolina, West Virginia, Maryland, Virginia, Ohio, Kentucky, Indiana, Illinois and Tennessee. While the Tennessee River drains into the Ohio River, the Tennessee Basin is considered separately and is not included in this report.

The major portion of the area covered by this report is included in the district covered by the Ohio River Water Sanitation Compact formed by eight of the States in the basin. This report includes the portions of North Carolina, Maryland, and Tennessee which drain into the Ohio River drainage system (exclusive of the Tennessee River drainage system) but which do not form part of the Sanitation Compact district. The portions of Virginia and Kentucky which drain to the Tennessee River Basin are included in the Sanitation Compact district but excluded from this report. In view of the association between the Sanitation Compact and the United States Public Health Service in matters related to pollution abatement in the basin, the above comparison of areas serves to avoid misinterpretation in correlating data pertinent to the Sanitation Compact district with the basin data.

The upper portion of the basin is hilly to mountainous, the southwestern part has rolling hills and wide valleys and the northwestern portion is level or gently rolling.

The location of the basin and its natural resources have combined to make the area one of the most important agricultural and industrial sections of the Nation. The value of the annual agricultural and industrial products is about 9 and 15 percent respectively, of the total annual value of these products in the Nation. Practically all types of industry exist in the basin.

The 1940 population of the basin was about 16,324,000. Preliminary 1950 census figures indicate a population in the basin of about 17,738,000.

Water uses in the basin include public and industrial water supplies, navigation, power development, fish and wildlife propagation, recreational purposes, irrigation and final waste disposal. In some areas ground water is available for small to moderately large demands. The demands for municipal and industrial supplies are increasing and availability of water for these uses is vital for the continued growth of this basin. In other areas uses of surface waters is required. Surface waters are used for large municipal and industrial supplies throughout the basin. Navigation developments provide one of the largest and most used systems in the world. Favorable locations exist for large scale development of hydroelectric power. Water uses for recreation have always been important in the basin and are becoming more important. Agricultural developments require widespread use for livestock water supplies. Use for irrigation may become increasingly important. The streams of the basin will continue to receive the final effluent from municipalities and industries. Conflicts between water uses are increasing along with population increase and industrial developments, one of the most important of which is the conflict between use of the streams for waste disposal and other uses.

Polluting wastes are discharges from 2,104 centers of population and from 1,264 industries through sewers not connected to municipal systems. Of the 2,104 municipal sources of pollution, 512 had 1940 populations exceeding 2,500; 557 had populations from 1,001 through 2,500; 545 had populations from 501 through 1,000; and 490 had populations of 500 or less. A large number of the listed industries have relatively small pollution loads. Many small canneries are included in the list and, in numerous instances, pollutional effects are minimized by lagooning wastes during critical periods and discharging them during high flow low temperature conditions. The total organic waste load discharged to the streams from 1,204 municipal sources of pollution is estimated at about 8,760,000 equivalent population and the organic waste load from 383 industrial sources is estimated at 4,525,000 equivalent population. The waste load discharged from 900 municipalities has not been determined. The organic waste load from 326 industrial sources has not been determined. Inorganic waste, not measured by population equivalent, is discharged from 635 industrial plants, 128 of which also discharge organic wastes. The type of waste from 48 industrial plants has not been determined. The reported total organic waste load discharged to the streams is estimated at only about 70 percent of the total load actually discharged. Inorganic wastes from the above industries include acid from steel plants, toxic metal wastes, phenols, and other taste and odor producing substances from coke and chemical plants, brines, sulphates, color producing substances, and silt from coal washing operations.

Acid mine drainage is the greatest single pollution problem in the basin and constitutes the greatest unknown with respect to satisfactory and economical means for control and abatement. The sources of mine drainage have not been listed in the report. Both active and abandoned coal mines contribute this pollution to the streams and the number of sources, particularly abandoned mines, are very numerous. Moreover, the number is increasing and the potential magnitude of the problem can be visualized from the fact that about 75 percent of the Nation's coal is supplied from the basin, only about 7 percent of the coal reserves have been touched and approximately 55 percent of the acid load comes from abandoned mines.

Damages from stream pollution occur to all water uses in the basin. These damages may be the result of bacterial pollution, deoxygenation, toxicity, acid conditions, chloride content, or the presence of color, odor, or taste producing substances. Stream pollution in this river basin results in damages which require relocation of water supplies, necessitate additions to water treatment plants, cause additional cost of water treatment, create hazards to public health from bacterial pollution, preclude use of waters for water supplies and recreation purposes, destroy or inhibit fish and other desirable aquatic life, and cause corrosion damage to equipment and structures. Many of the pollution problems are interstate in character and became of such importance that, in 1948, eight States in the basin joined together in a compact for a cooperative approach to the solution of the problems. The damages from pollution are both tangible and intangible and no estimate of their magnitude in terms of dollars is feasible at the present time. Undoubtedly, the overall benefits which will result from pollution abatement demand that such abatement be attained.

Of the 2,104 sources of municipal pollution, 224 have primary treatment and 342 have secondary treatment. Approximately 38 percent of the population served by sewers is connected to these treatment plants. However, at least 159 of these plants are inadequate in capacity. Treatment facilities of some type have been reported for 451 of the 1,264 industries listed as sources of pollution. The status of treatment at 277 locations has not been determined. At least 164 of the industrial waste treatment plants are inadequate in capacity. Ninety-eight municipal and 77 industrial treatment facilities are reported to be unsatisfactorily operated.

Thirty-three municipal treatment plans were constructed or improved between 1946 and 1949 inclusive. While the progress indicated by the construction of these plants in the four-year postwar period appears inadequate, it must be realized that the period for some two years following the war was one of unsettled labor and material markets. Many projects are now in the planning, financing, and construction stages. There were 160 industrial waste treatment plants constructed in this period. A large percentage of these treatment plants were constructed at canneries.

On the basis of existing data new treatment plants are required for 911 municipal sources of pollution and 539 industrial sources. Enlargements of or additions to existing facilities are required for 132 municipalities and 108 industries. Existing treatment facilities for 39 municipalities and 33 industries should be replaced. Requirements have not been determined for 695 municipal and 353 industrial sources of pollution. At this time 327 municipal and 231 industrial sources of pollution require no project for pollution abatement. Corrective measures have been initiated for 495 municipal and 212 industrial sources. Of the 1,777 municipalities listed as requiring projects for pollution abatement or listed as sources of pollution for which requirements had not been determined, there are 408 which had 1940 populations in excess of 2,500; 451 which had populations from 1,001 to 2,500; 488 which had population from 501 to 1,000; and 430 which had populations of 500 or less.

Continued attention should be given to securing good operation of municipal and industrial waste treatment plants.

Low flow regulation, where it is feasible, is a valuable supplement to waste treatment plants in reducing the damaging effects of pollution. Flow regulation in addition to that which has been provided is desirable.

Research is necessary to devise and perfect practical and economical methods of treatment of industrial wastes which are not susceptible to known effective methods of treatment or for which present methods are costly. Acid mine drainage, an important source of pollution in this basin, is an example of industrial waste for which no satisfactory or economical treatment method is presently known.

Effective State legislation is necessary to promote pollution abatement. Such legislation has been obtained in some States recently. Some States are proposing additional legislation and possibly some of the States will find it necessary to extend or supplement existing laws in the future. The water pollution control program in Ohio[1] and North Carolina[2] would be strengthened by more comprehensive legislation than now exists. There are present needs for strengthening the legislation in several States, particularly Illinois, Tennessee[2] and West Virginia.

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[1] Comprehensive water pollution control legislation was enacted by the Ohio legislature in June 1951.

[2] Changes have been made in Tennessee and North Carolina legislation subsequent to the preparation of this report.

Restrictive and other legislation affecting the financing of pollution abatement programs requires consideration in some instances.

Continuation and expansion of informational programs, designed to inform the public fully of the damages accruing from pollution and the benefits to be derived from pollution abatement, are a necessary part of an effective pollution abatement program.

On the basis of available data, which are incomplete at this time, and assuming the average cost index for 1949, the approximate capital cost of facilities required for pollution abatement in the basin is estimated at $350,000,000 to $400,000,000, plus additional requirements for abatement of pollution due to inorganic wastes and acid mine drainage.

CONCLUSIONS

1. The water resources in the Ohio River Basin are vitally important to the continued development of the basin. Industrial and municipal water supply demands are increasing and assurance of the continued availability of water for these uses is necessary. Navigation uses are highly developed and plans for expansion are being made. The hydroelectric power potential in the basin is an important resource. Use of the streams for all types of recreation is important to the health and well being of the public.

2. Pollution is widespread in the basin and consists of wastes both municipal and industrial in origin. The industrial pollution is of both an organic and an inorganic nature. The degree of pollution is such as to cause large tangible and intangible damages to major water uses.

3. Acid mine drainage is the greatest single pollution problem in the basin and constitutes the greatest unknown with respect to satisfactory and economical means for control and abatement. Uncontrolled operations will result in accumulative damages to practically all water uses if permitted to continue. Because of the seriousness of these present and potential damaging effects, the combined efforts of industry and all agencies of government, interested in either the coal or water resources of the basin, will be required to find an early and satisfactory solution to the problem.

4. Pollution of the streams causes damages to public health which may occur either directly, such as from use of contaminated raw water supply sources and from use of unsafe waters for recreational purposes, or indirectly, such as from use of more palatable but less safe alternate water supplies or from elimination of healthful recreational activities.

5. The data in the report indicate that there are sufficient basic information available to proceed immediately with construction of many waste treatment facilities in accordance with a sound program of pollution abatement. Additional data on volume of wastes, degree of treatment, water uses, water quality objectives, and treatment methods are required to supplement the program.

6. New or improved waste treatment facilities are required for a large percentage of the municipal and industrial sources of pollution. While progress in construction of these facilities has not been too great in the unsettled postwar period, preliminary action in the form of abatement orders, preparation of plans, promotional work, establishment of the Ohio River Valley Water Sanitation Commission, and other action, has set the stage for rapid advancement in pollution abatement. At this time there is a national problem relative to the extent to which restrictions on use of critical materials is necessary in the interest of mobilization for defense. Moreover, this problem may vary in acuteness with changing circumstances, unpredictable at present. However, pollution abatement necessary to preserve public health and to satisfy present and expanding public and industrial water supply requirements is in the interest of the national welfare. It is highly desirable that the impetus which has been given to the pollution abatement program, by the concentrated efforts of State, interstate, and Federal agencies, be maintained at the highest level consistent with other needs for the Nation's security.

7. The water pollution control programs of the various States should be strengthened, where necessary, by added legislation. A specific example is the need in Ohio[3] for more comprehensive legislation than now exists.

8. About 17 percent of the existing municipal and industrial treatment facilities are unsatisfactorily operated. Although this small percentage reflects credit on State and local authorities responsible for the supervision of operation, continued attention to this problem is needed to secure maximum benefits from investments in waste treatment facilities.

9. The full success of a pollution abatement program depends on public support. Continuation and expansion of informational programs related to needs for and benefits of pollution abatement are necessary to obtain this support.

10. The principal financial problems related to promotion of pollution abatement projects are those concerning "willingness to pay" and are more properly considered as informational and enforcement problems. Problems related to ability to finance and restrictive legislation should receive attention where necessary to obtain effective pollution abatement.

11. Low flow regulation is, in many instances, an important supplement to waste treatment.

12. Research programs are needed by develop satisfactory methods and to improve existing methods of industrial waste treatment.

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[3] Comprehensive water pollution control legislation was enacted by the Ohio legislature in June 1951.

RECOMMENDATIONS

1. It is recommended that informational programs, designed to inform the public fully of the damages accruing from pollution and the benefits to be derived from its reduction, be continued and expanded.

2. Provisions should be made to facilitate financing of municipal waste treatment facilities in locations where adequate provisions do not exist.

3. A coordinated research program should be carried on by industrial, educational and governmental agencies to improve and develop industrial waste treatment methods. This should include consideration of the acid mine drainage problem.

4. Continued changes should be made in State legislation related to pollution control to meet existing needs or to meet needs as they develop. It is recommended that more comprehensive pollution abatement and control legislation be provided in Ohio[4] and North Carolina.[5] There are present needs for strengthening the legislation in many of the States, particularly in Illinois, Tennessee[5] and West Virginia.

5. Enforcement powers of regulatory agencies should be applied vigorously were necessary to obtain construction of treatment facilities.

6. Support by local, State, interstate, and Federal agencies and other groups and organizations concerned with water conservation and pollution control, should be given to State water pollution control agencies in securing adequate appropriations from State legislatures to carry out the planning, enforcement, informational and operational functions of the pollution abatement program.

7. Attention should be given to development of a low flow regulation program to supplement municipal and industrial waste treatment plants.

8. A comprehensive program should be developed in detail. Data indicated to be missing in the report should be obtained, and detailed treatment requirements and water quality objectives should be established.

9. A continuing report on accomplishments and needs should be initiated for all of the States in the basin. This action is being undertaken by the Ohio River Valley Water Sanitation Commission for those States which are members of the Compact.

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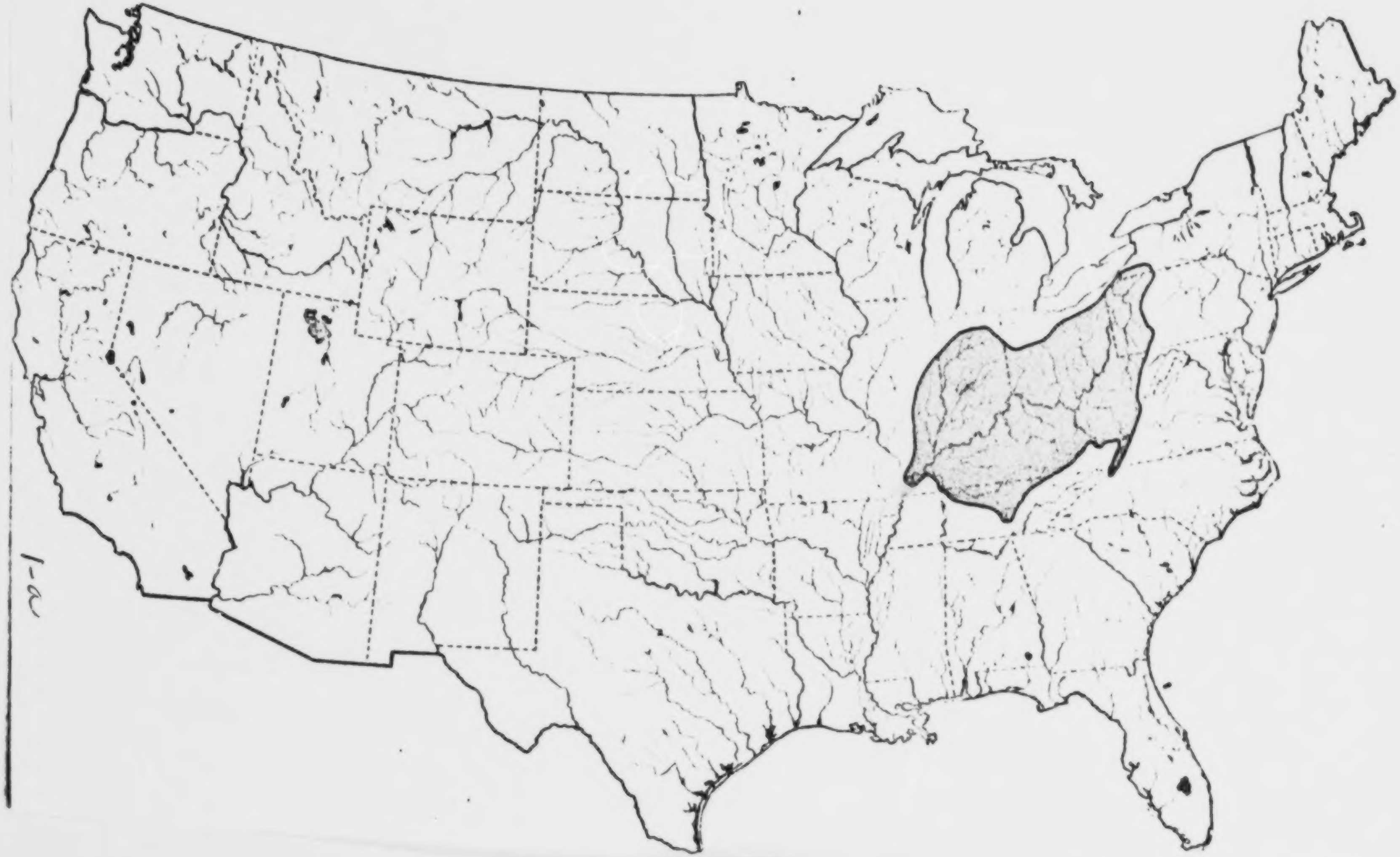
[4] Comprehensive water pollution control legislation was enacted by the Ohio legislature in June 1951.

[5] Changes have been made in Tennessee and North Carolina legislation subsequent to the preparation of this report.

LOCATION MAP

Ohio River Drainage Basin



GENERAL DESCRIPTION

Historical Background

The area included in the Ohio River Basin has played an important part in the development of the Nation from its beginning to the present time. The area was alternately claimed by France and England and the final superiority of England resulted in the development of an English speaking nation. The natural path of the westward movement of civilization passed through the basin and the main river served as an important artery of transportation. The natural resources, including fertile land, forests, coal and other minerals, and water resources, made the area attractive for rapid settlement and development. Today the basin is one of the most important agricultural and industrial areas in the Nation. The use of the streams for various purposes has increased with the development of the basin. The main stem and many of the major tributaries have been improved for navigation. The waters of the basin serve an ever increasing demand for industrial and domestic water supply. Unregulated discharge of waste has increased from the original small quantities, which did little damage, to the present condition of gross pollution which damages other water uses and endangers public health.

Physical Characteristics

The Ohio River is formed by the confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pa. From this point the river flows in a northwesterly direction for about 25 miles through Pennsylvania, then turns westward to East Liverpool, Ohio, located near the Ohio-Pennsylvania border. The river forms the entire eastern and southern boundary of Ohio below the town of East Liverpool, flowing in a generally south and southwesterly direction between Ohio and West Virginia, and in a generally west-northwesterly direction between Ohio and Kentucky. At the Ohio-Indiana border the river again takes a generally southwesterly course, forming the southern boundaries of Indiana and Illinois and the northern boundary of Kentucky, and finally joins the Mississippi River at Cairo, Ill., 981 miles below the point of origin. The Ohio River has 18 major tributaries (exclusive of the Tennessee River), their names and points of confluence in miles below Pittsburgh being as follows: Allegheny and Monongahela Rivers, 0 miles; Beaver River, 25.4 miles; Muskingum River, 172.2 miles; Little Kanawha River, 184.6 miles; Hocking River, 199.4 miles; Kanawha River, 265.7 miles; Guyandot River, 305.3 miles; Big Sandy River, 317.1 miles; Scioto River, 356.5 miles; Little Miami River, 464.1 miles; Licking River, 470.2 miles; Miami River, 491.1 miles; Kentucky River, 545.7 miles; Salt River, 629.9 miles; Green River, 784.2 miles; Wabash River, 848.0 miles; and the Cumberland River, 920.4 miles.

The basin has a drainage area of about 163,000 square miles, about 5.5 percent of the area of the United States, and embraces parts of eleven States, their names and drainage area tributary to the basin in each being as follows: New York, 1,955 square miles; Pennsylvania, 15,620 square miles; Maryland, 428 square miles; Virginia, 4,097 square miles; North Carolina, 770 square miles; Ohio, 29,570 square miles; West Virginia, 20,610 square miles; Kentucky, 38,320 square miles; Tennessee, 11,075 square miles; Indiana, 29,135 square miles; and Illinois, 11,440 square miles. Eight of the above States are members of the Ohio River Valley Water Sanitation Compact. Three States, Maryland, North Carolina, and Tennessee, are not members of the compact. The areas of Virginia and Kentucky included in the compact are greater than those listed above, since the areas from these two States tributary to the Tennessee River Basin are excluded from this report.

Most of the geological formations in the basin belong to the Paleozoic group. Formations in a small part of the area near the mouth of the Ohio River belong to the Cretaceous period of the Mesozoic era. The coal bearing formations of the Pennsylvania period occur in the eastern part of the basin including portions of Pennsylvania, West Virginia, and eastern Kentucky and in the western part, including portions of Illinois, Indiana, and western Kentucky.

The history of the physiography of the basin is contained in three stages, namely; the early Teays, the deep stage and the present system. Prior to the ice age the original system of rivers flowed to the north except in the western part of the basin. This early system of drainage was disrupted with the advance of the earlier ice sheets resulting in the cutting of a new system of deep channels flowing in a general westerly direction. Later the Illinoian and Wisconsin glaciers covered portions of Illinois, Indiana, and Ohio and filled up the deep valleys. The present system of drainage has been developed since glacial times, following the deep valley systems to a marked extent in unglaciated areas but having no particular relation to the old system in the glaciated areas.

Generally, the basin is mountainous in the eastern portion, graduating to lower, more rounded hills to the west with rolling hills in the southwestern portion and level to gently rolling in the northwestern portion. Practically all of the area lying east of a northeast - southwest line, roughly dividing Ohio, Kentucky and Tennessee into equal parts, lies in the physiographic province known as the Appalachian Plateaus. This province is further divided into: a section of mature glaciated plateau in southwestern New York, northwestern Pennsylvania, and northeastern Ohio; the Allegheny Mountain section along the eastern border; the Kanawha section which includes the great Pennsylvanian, or Eastern, coal fields and embraces most of eastern Ohio, most of Pennsylvania lying in the basin, practically all of West Virginia, and small parts of New York, Kentucky and Virginia; and the Cumberland Plateau and Cumberland Mountain section, a part of which lies in the basin. The area lying west of the Appalachian Plateaus and north of the Ohio River, except for a considerable portion of southern Indiana, is composed almost entirely of the Eastern Lakes and Till Plains sections of the Interior Plains division and lies in the glaciated part of the basin. The southwestern part of the basin lies in the Interior Plateau province of the Interior Plains division and is entirely unglaciated. This area includes the section known as the Blue Grass district in north central Kentucky. A low maturely dissected plateau area with silt filled valleys lies in the extreme southwestern portion of the basin.

Climate-Hydrology

The average annual temperature in the basin varies from slightly less than 60° F. in the southwestern part to about 45° F. in the northeastern part, with an average for the whole basin of about 55° F. The average January temperature lies between 25° F. and 35° F., while the average July temperature is between 70° F. and 80° F. The highest temperatures which have been observed vary from 115° F. in the southwestern part to 100° F. in the northeastern part. The lowest temperatures observed vary from -20° F. to -30° F. in various parts of the basin. The area lies in the temperate zone and the climate is suitable for agriculture throughout the basin, the average growing seasons between killing frosts varying over the basin from extremes of 120 days to 200 days, with most of the area having a growing season of about 180 days.

The average annual precipitation in the basin varies geographically from about 34 to 52 inches, the lower values occuring in the northwestern and northeastern parts of the basin. In general, the axis of the basin lies in the path of the moisture-bearing low-pressure formations from the Gulf, resulting in a general pattern of decreasing rainfall, modified somewhat by topographic conditions, from the lower part of the basin to the upper part. The average rainfall does not show a great seasonal variation, there being only slightly more rain in the spring and summer months than in the fall and winter months. However, there are wide variations from the average and in extreme drought years the precipitation may be as low as 50 percent of the average in some areas. Also, excessive precipitation concentrated in short periods of time has occurred. A local hourly rainfall varying from 2.5 inches in the northeastern part of the basin to 3 inches in the southwestern part may be expected once in 50 years and a 24-hour rainfall varying from four to six inches may be expected once in 50 years. Higher rates have occurred at various locations.

The variations in rainfall, vegetation conditions, temperature changes, and snow storage have combined to cause wide variations in run-off and stream flows, notably the low flows of 1930 and the disastrous floods of 1913 and 1937. Major river improvements for flood control and other purposes, constructed in recent years and continuing to be constructed at the present time, have altered the natural relationships between rainfall and run-off on the main stem and several of the major tributaries.

Economic Development

The natural resources in the basin have played an important part in its economic development. The natural resources include coal, petroleum, natural gas, building stone, rock asphalt, clays, fluorspar, salt, iron, sand and gravel deposits, and small quantities of other minerals. Plentiful surface and ground water supplies are a very important natural resource. In addition to their use for public and industrial water supplies, the surface waters are used extensively for navigation, recreation, fish and wildlife purposes, and power production, the potential of the latter use being undeveloped to a large extent. The Appalachian, or Eastern, coal fields are the largest in the world and most of these fields are in the Ohio River Basin. Part of the Eastern Interior coal field is located in the western part of the basin in the States of Indiana, Illinois, and Kentucky. Between 70 and 80 percent of the bituminous coal mined in the country is produced in the basin. Natural gas is found in most of the States in the basin, most of the production coming from West Virginia, Ohio, Pennsylvania and Kentucky. For many years the natural gas produced in the basin has been a significant percentage of the total produced in the Nation. Petroleum is found throughout the area. However, the production in the basin is only a small percent of the Nation's total. Salt is produced in the basin in the States of Ohio and Kentucky and amounts to about 20 percent of the Nation's total production. Limestone, sandstone, sand, gravel, and clays are abundant and industries engaged in processing these for commercial uses form an important part of the economy of the basin.

Industries are highly developed and quite diversified. Major industries include primary metal industries, metal fabrication, production of petroleum and coal products, industries related to the processing of agricultural products, rubber industry, pulp, paper and strawboard industry, and chemical industries. Other important industries include cement, soap, beverages, clay products, building accessories, glass, textile, leather products, lumber and lumber products, printing and publishing, and other miscellaneous industries. The value of the products manufactured in the basin is roughly estimated at 15 percent of the value of products manufactured in the Nation.

Agriculture is one of the principal pursuits in the basin, approximately 70 percent of the area, including cultivated lands, pasture lands, and woodlands, being used for that purpose. Based on farm income, the value of the farm products is about 9 percent of the Nation's total.

The 1940 population in the basin was about 16,324,000 of which slightly more than 50 percent was classed as rural. This population represented about 12 percent of the Nation's total. Preliminary 1950 census figures indicate a population of about 17,738,000, an increase of over 8 percent in the past decade.

USES OF WATER RESOURCES

Water uses in the basin include industrial, domestic, and livestock water supplies, navigation, recreation, fish and wildlife propagation, hydroelectric power, auxiliary irrigation, and final waste disposal.

There are 728 municipalities in the basin which obtain water from surface sources. These surface sources supply a population of approximately 6,381,000, which is about 70 percent of the total population served by public water supplies. In addition to industries which obtain water from municipal supplies there are many which have separate sources. The combined industrial water demands from all sources including cooling water and process water demands, far exceed the demand for domestic uses. While the apparent value of water supplies may be expressed in terms of the cost of production or sales value, the true value to the economy of the basin can be realized only by comparison with areas where adequate supplies are not available. When considered from this viewpoint the necessity for preserving the waters of the basin for the primary uses of domestic and industrial water supplies becomes forcibly apparent.

The entire main stem of the Ohio River and parts of several of the major tributaries have been developed for navigation. The system is one of the most important and most used systems in the world. Use of the rivers for transportation was an important factor in directing the path of civilization during the early westward expansion of the country. Since the early days of canoes and flatboats, navigation has developed to the point where, according to the Department of the Army, Corps of Engineers report for 1949, more than 6.9 billion ton-miles of freight traffic were transported through this navigation system. Coal and coke, stone, gravel, sand, oil and gasoline constituted about 85 percent of the total tonnage. Structures for the navigation system include 46 locks and dams on the main stem of the Ohio River and 82 locks and 81 dams on the Allegheny, Monongahela, Muskingum, Little Kanawha, Kanawha, Big Sandy, Kentucky, Green, and Cumberland Rivers. Studies are under way for the extension and improvement of the system.

The waters in the basin are being increasingly used for recreational purposes, including bathing, boating, and fishing. The increase in use for these purposes is no doubt the result of increasing density of population, better transportation, and more available recreation time resulting from a shorter work week. Certainly changing stream conditions, particularly with respect to fishing, have not added any incentive for increased recreational use. The present use of the streams for recreation, however large, is not, therefore, an accurate measurement of the potential use. When present conditions in some streams are compared with the excellent fishing of 30 or 40 years ago there can be little doubt that return of those conditions, even to a partial degree, would substantially increase recreational use. The recognition given to the importance of recreational use is demonstrated by the installation in recent years of numerous impoundments for that purpose, or inclusion of provisions for recreation in impoundments for multiple purposes, by State and Federal agencies.

Use of the waters of the basin for final waste disposal is a valuable and necessary use. It is apparent that the large volumes of water used for municipal and industrial purposes in heavily populated areas must eventually be returned to the natural surface drainage systems. The capacity of the streams of the basin to absorb the pollution load contained in the waste water without causing damage to other water uses is not without limitation and, at present, this limitation is grossly exceeded. Allocation of the waste disposal capacity of the streams to the various industrial and municipal users, largely to be accomplished by fixing water quality objectives and waste treatment requirements, is one of the major problems of the stream pollution abatement program.

There are many locations in the basin where stream conditions and topography are excellent for hydroelectric power development. Compared to the potential, this use of the streams is relatively undeveloped. Existing Federal, non-Federal and industrial plants have a capacity of about 570,000 kilowatts. Ten other plants, having a capacity of about 930,000 kilowatts, have been authorized for construction by the Corps of Engineers and two of these are now under construction. Reports by the Corps of Engineers indicate that favorable sites exist for development of an additional capacity of about 2,800,000 kilowatts. There are other sites favorable for development of power. Preliminary estimates by the Federal Power Commission staff indicate that about 6,500,000 kilowatts are potentially available at projects which are adaptable in general plans for the comprehensive development in the basin. More detailed studies would be necessary to determine how much of this potential power is feasible for development.

As previously indicated under discussion of economic development, agriculture is an important activity in the basin. Raising of livestock is widespread and use of water for livestock water supplies is an important water use.

Irrigation has not been developed to any great extent at this time. However, there are recent indications that water for auxiliary irrigation may become more important in the future.

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POLLUTION CONTRIBUTED TO WATER RESOURCES

The pollution load from municipal sewerage systems is indicated by data in table A. There are 2,104 centers of population which have been reported by State water pollution control agencies as contributing pollution to the streams of the basin. These population centers include incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, institutions, and resorts, and other population centers which may be considered as a unit in studies of stream pollution. Classified on the basis of the 1940 populations, 512 of these sources of pollution had populations in excess of 2,500; 557 had populations from 1,001 through 2,500; 545 had populations from 501 through 1,000; and 490 had populations of 500 or less.

The waste load discharged to the streams from 1,204 municipalities is estimated at about 8,760,000 population equivalent. Of these 1,204 locations, 35, with a combined population of about 30,000 have no comprehensive public sewerage system; 1,167 with public sewerage systems have an estimated combined population served of about 7,720,000; and the populations served at two locations have not been determined. The waste load discharged to the streams from 900 municipalities has not been determined. Of these 900, there are 512 with an estimated combined population of 298,000 which have no comprehensive public sewerage system; 53 with no comprehensive sewerage system for which population data have not been obtained; and 27 other locations for which the population served by sewers has not been estimated. The total amount of industrial waste discharged to municipal systems is not indicated by the data, since there are numerous instances where estimates of waste discharged to the streams have not been obtained and in other instances measurement of waste load has been made after treatment.

Table B lists the types of industries in the basin which discharge wastes to the streams through separate outlets (i.e. not connected to municipal sewerage systems). The table lists a total of 1,264 industries; 383 of which discharge an estimated organic waste load equivalent to a population of 4,525,000; 326 of which discharge an undetermined amount of organic waste load; 635 of which discharge inorganic wastes (these include 128 industries also listed above as discharging organic wastes), and 48 of which discharge wastes of an undetermined type. Based on data representing 1940 conditions (Ohio River Survey Report data) the organic waste load from locations for which recent data are not available equals or exceeds the load reported for the 383 industries.

The industries discharging the majority of the organic waste load to the streams include food processing plants, paper and allied products plants, and chemical plants. Inorganic wastes include acid from steel plants, toxic metal wastes, phenols and other taste and odor producing substances from coke and chemical plants, brines, sulphates, color producing substances, and silt from coal washing operations.

Phenolic compounds are pollutants of considerable significance throughout the basin. While such wastes are of minor importance from an oxygen depletion standpoint, they give rise to obnoxious tastes and odors in public water supplies. Their removal within the water treatment plant is most difficult, if not impossible, and in any event extremely costly. They are also of considerable public health significance as objectionable tastes and odors in the public supply may cause consumers to seek more palatable sources although the latter may be of inferior sanitary quality.

In view of the large number of municipal and industrial sources of pollution for which the organic waste load is not reported, it is estimated that the combined reported load is only about 70 percent of the total organic load.

The significance of the pollutional effects of acid mine drainage has not been included in the tabular data. The sources of acid mine drainage pollution are very numerous, particularly abandoned coal mines, and are ever increasing. The most comprehensive recent summary of acid mine drainage pollution available is contained in the Ohio River Pollution Control Survey (published as House Document 266, 78th Congress, 1st Session). This report reflects conditions as of about 1940. The total acid load before sealing accomplished at that time was estimated in terms of its calcium carbonate equivalent as follows: Active mines, 1,105,000 tons per year; marginal mines, 175,000 tons per year; abandoned mines, 1,141,000 tons per year; the total being 2,421,000 tons per year. After sealing, the residual acid load from all mines was estimated at 1,801,000 tons per year.

While no recent quantitative data on the total acid load discharged to the streams are available, there is every reason to believe that the present load is substantially greater than reported in the above report. In some areas a great many of the previously sealed mines have been reopened for production of coal and new mines have been developed. The effectiveness of sealing, as such, is open to question in some instances, particularly in the case of drift mines, because of the failure of the seals to exclude oxygen from the mines. Moreover, there has been inadequate maintenance of the seals. The sealing program, as differentiated from sealing was beneficial to the extent that it diverted water from entering drift mines. The magnitude of the acid mine drainage problem can be recognized when it is realized that approximately 75 percent of the Nation's coal supply comes from the basin, only about 7 percent of the coal reserves have been touched, and approximately 55 percent of the acid load comes from abandoned mines.

Corrective action on abandoned mines presents a serious financial and administrative problem because many of the mined out areas are no longer under the control of responsible coal operators. No entirely satisfactory and economical method of eliminating this source of pollution has yet been developed. The State water pollution control agencies in the basin are aware of the damages caused and the needs for control. However, their powers are often limited by legislation exempting coal operations from stream pollution regulatory authority. Pennsylvania has spent over 2.5 million dollars on basic research and mine sealing during the postwar period. The coal industry has also contributed some financial support to basic research, although this expenditure is not commensurate with the seriousness of the problem and its potential effects on the water resources and economy of the basin.

More than half of the acid load originates in the Monongahela and Allegheny River Sub-Basins. Other areas where the acid load is significant are along the main stem and minor tributaries in Ohio and Pennsylvania, and in the Muskingum, Hocking, Guyandot, Big Sandy, Kentucky, Green, Wabash and Cumberland Sub-Basins. There are areas where the total acid load is not great but where intermittent or occasional acid discharges have almost completely ruined the streams for fishing.

Acid mine drainage is the greatest single pollution problem in the basin and constitutes the greatest unknown with respect to satisfactory and economical means for control and abatement.

Wastes from coal washeries are also important sources of pollution throughout the coal producing areas. In this case, however, the knowledge and methods necessary to solve the problem are well developed and corrective action can and should proceed immediately.

Another source of pollution which has not been considered in detail is pollution from oil fields and from pipelines and barges transporting oil products. While oil field wastes may be significant, they are not widespread in the basin. Further information will be required to determine the extent of this pollution.

Silt is washed into the streams in large amounts from agricultural lands. This form

Table A. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)*	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	1,204[1] [2]	7,750,441[1]	8,759,535[1] [2]
Having population data available (Data on pollution load to watercourse incomplete or not available)	900[2] [4]	1,694,300[3]	Not applicable
Total	2,104	9,444,741	--

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes data for 35 communities having no comprehensive public sewerage systems. These 35 communities have an estimated combined population of 29,967.

[2] Includes 2 communities for which data concerning the population served have not been obtained.

[3] Includes data for 512 communities having no comprehensive public sewerage systems. These communities have an estimated combined population of 297,987.

[4] Includes 80 communities for which data concerning the population served have not been obtained. Of these, 53 have no comprehensive public sewerage systems.

of pollution has not been considered in detail in this report. It is believed that silt removal from the land is more significant from the standpoint of economics related to agriculture and that interest in its abatement is more justified from that viewpoint than from the viewpoint of pollution abatement. Cooperative study with other agencies is required in connection with pollution problems caused by silt pollution. In this connection the program of the Soil Conservation Service of the Department of Agriculture includes recommended practices which will reduce the silt and sediment load on the streams of the basin.

Silt from non-agricultural lands also causes serious damages in the basin. Areas where strip-mining of coal is practiced are of particular concern in this respect. As an example of the damages which result, the capacity of one water supply reservoir in West Virginia has been reduced by 76 percent and the hardness of the water increased by at least 200 percent as a result of recent strip mining operations.

Table B. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	383[1]	4,524,738
Producing organic wastes	326[2]	Undetermined
Producing inorganic wastes	635	Not applicable
Producing wastes of undetermined type	48	Undetermined
Total	1,264[3]	—

*Industries having separate outlets and discharging wastes directly to watercourse.

[1] Includes 69 plants also producing inorganic wastes.

[2] Includes 59 plants also producing inorganic wastes.

[3] Total adjusted to correct for duplication noted in footnote marked thus, [1] and [2].

DAMAGES TO WATER RESOURCES FROM POLLUTION

Damages occur to all water uses of the streams from pollution. These damages result from both industrial and domestic wastes and, as would be expected, vary in extent with the degree of pollution and the existing uses or the potential uses held in abeyance because of unsatisfactory water quality. Damages may be the result of bacterial pollution, deoxygenation from organic pollution, toxicity, acid conditions, increased hardness, chloride content, or the presence of color, odor, or taste producing substances.

There has been no attempt to evaluate, in terms of dollars, the total damages due to pollution. In fact, while some of the damages may be evaluated, it is very difficult, or even impossible, to evaluate all of the damages. For example, it may be possible to estimate damages to a water supply on the basis of extra treatment requirements to safeguard against bacterial pollution. Yet, the damages chargeable to the extra hazard or to the psychological effects of knowing that the water supply comes from processed sewage are not so easily measured. Damages to recreational use of the streams, aesthetic values, or potential uses, are likewise difficult to measure in terms of dollars. Yet these damages exist and are universally recognized. Similarly, damages to public health and general walfare are extensive but hard to evaluate. Tastes and odors in public water supplies may lead to use of less safe, taste-free water. Recreational use of unsafe waters may persist even though pollution exists, or more costly substitutes may be required to replace damaged natural recreational facilities. Even where every reasonable precaution is taken in the water treatment plants, there is always a hazard in using polluted water as a source of water supply. Many instances are known where this hazard is real and not speculative.

Damages due to acid mine drainage are most significant in the upper part of the basin, principally in the Allegheny and Monongahela Sub-Basins. As an example, the Conemaugh River in Pennsylvania is so polluted with acid mine drainage that it is entirely useless for either domestic or industrial water supplies and has necessitated extensive and costly developments of other sources of supply. Annual damages to water supplies, structures, and navigation equipment above the Ohio, West Virginia and Pennsylvania State lines were estimated to amount to about $2,071,000 annually in 1940 and the forecasted annual damages for 1960 (based on 1940 price index) were estimated at $3,190,000 (See Ohio River Pollution Control Survey, House Document 266, 78th Congress, 1st Session). On the basis of present price indices the dollar damages would be increased. Additional damages occur to recreational uses and to potential industrial and municipal uses. Also to be added to the acid mine drainage damages are the damages in other sub-basins in the basin. Instances are known where even so-called minor acid mine drainage has caused serious damages. Two minor tributaries in Ohio, draining an area of about 1,000 square miles, normally show no effects of acid mine drainage. However, on more than one occasion, almost complete fish kills have occurred.

In the Youngstown area on the Mahoning River, use of the waters for industrial cooling water and for industrial and municipal waste disposal has resulted in pollution damages which accumulate all the way to the Beaver and Ohio Rivers and are interstate in character. No direct estimate of the tangible damages had been made. However, based on the willingness of industry and municipalities in the area to contribute many millions of dollars for an adequate supply of water, the damages are substantial.

In 1939, Marietta, Ohio, changed its water supply source from the Ohio River to wells and the Muskingum River in order to avoid tastes and odors and other contamination effects of the pollution in the Ohio River, even though the change incurred extra expense for treating the harder waters of the new sources. Now it is reported that chloride pollution in the Muskingum River is causing difficulty.

Bacterial pollution in the main stem of the Ohio and many of the tributaries is so great as to exceed recognized upper safe limits for many existing surface water supplies. The situation is especially critical below Pittsburgh, in the Huntington-Ashland-Ironton area, at Cincinnati, and below Louisville, Ky. and Evansville, Ind.

The surface water supplies of the basin, especially downstream from industrial outfalls, are almost continually plagued with taste and odor problems. These conditions are especially serious throughout the upper portion of the Ohio, the Kanawha, and the Beaver.

The West Virginia Water Commission considers the entire main stem of the Kanawha River from Belle (above Charleston) to the mouth unsatisfactory for water supply, fish propagation, and recreational purposes, because of industrial and domestic pollution.

Oxygen depleting wastes and silt have reduced the quality of the water in streams in many parts of the basin to the point where fish and other aquatic life cannot survive.

Damaging conditions exist in the Scioto River below Columbus, Ohio, during low flows due to lack of adequate dilution water even after treatment of wastes.

Similar conditions to those described exist throughout the basin. Damages to water supplies, fish kills, unsatisfactory water for livestock, elimination of recreational areas, and other damages are repeated over and over.

In addition to the many local or extensive intrastate damages there are many widespread interstate damages from pollution. These latter damages have been the subject of much attention by various State agencies and individuals for many years which resulted in the formation of an interstate compact to abate pollution in 1948. (This compact is discussed in greater detail under the heading "Pollution Control Measures In Effect".)

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

Benefits resulting from stream pollution abatement will accrue to public, industrial, and livestock water supplies, to flood control, navigation and power generating structures, to navigation interests, and to the general public from the standpoint of public health, recreation, and aesthetic values.

Benefits to public water supplies from pollution abatement will include reduction in treatment costs, reduction in requirements for increase in treatment processes, elimination of necessity for changing source of water supply in instances where the situation is becoming critical, reduction of the public health hazard, and improvement of psychological effects now caused by the knowledge that the water supply comes from a polluted source.

Industrial supplies will benefit from improved quality of water supply. Some industrial processes require a high quality of water and pollution abatement will reduce present treatment requirements and may facilitate industrial growth by making a satisfactory supply available.

Water supplies for livestock will be substantially improved. In view of the importance of agriculture to the economy of the basin, benefits to these supplies will be important.

Acid conditions in some of the streams cause damages to structures and equipment located in them. Elimination of these conditions would not only restore such waters to a quality suitable for other legitimate uses but would result in annual savings amounting to millions of dollars.

General benefits to the public include both tangible and intangible benefits. These will include preservation or restoration of recreational areas for boating, swimming, fishing, and other uses. Pollution abatement will reduce public health hazards and promote the general welfare of the public. The benefits permeate through the whole structure of society and are difficult to conceive and more difficult to evaluate. It is known that substantial improvement in water areas in one section of the Cumberland River Sub-Basin has resulted in a seven fold increase in recreational use, mostly by local inhabitants, in a little over a decade and the increase is still mounting. The economic values, as well as the intangible values, of such a development are significant.

Control of pollution discharged to the streams will have a benefit which is both peculiar and substantial with respect to industry. It must be accepted that, in the end, the tremendous amount of water used by municipalities and industries will be returned to the streams. It must also be recognized by all concerned that the quality of the return water discharged to these streams will be regulated by water pollution control agencies so that the use for waste disposal is compatible with other water uses. The deduction is apparent and clear that, if the waste assimilating capacity of the streams is usurped by present uses, there remains no opportunity for further industrial expansion which, after appropriate treatment of wastes, will need some stream capacity for assimilating waste.

Proper pollution control will provide equitable use of the natural waste purification capacity of the streams by various industries. Restoration of polluted waters to a condition where they may be economically and safely used for industrial and domestic water supplies will have a beneficial effect on the national economy and security. The water needs of a growing population and of expanding industries, particularly those industries related to security in times of emergency, will not permit continued wasting and degradation of the water resources.

POLLUTION PREVENTION MEASURES IN EFFECT

Data on existing municipal sewage treatment plants are contained in tables C and E. Of the 2,104 sources of municipal pollution, 224, or 10.5 percent, have primary treatment and 342, or 16.3 percent, have secondary treatment. The remaining 1,538, or 73.2 percent, discharge untreated sewage into the streams of the basin. On a population basis about 9.5 percent is tributary to primary treatment and about 29 percent is tributary to secondary treatment. It will be noted that the municipalities listed as sources of pollution include 600 which have no comprehensive public sewerage system, 547 of which have a total combined population of about 328,000, while the population for 53 have not been determined. While inclusion of the total population served for these communities is on the high side, the percentage error is small compared to the total population discharging sewage through sewer systems. The data do not include information on the total industrial and domestic waste load discharged into municipal sewerage systems. Consequently, there is no accurate estimate of the reduction in waste load by present municipal sewage treatment plants. Also, as indicated by table E, at least 159 of the existing municipal plants are inadequate and do not give the percentage reduction in waste load ordinarily obtained from primary and secondary treatment plants.

Table D classifies the industrial sources of pollution according to type of industry and shows the status of treatment facilities for such industries. The predominant industries having separate outlets and discharging wastes directly to streams are food processing, primary and fabricated metal, chemical, petroleum and coal, paper and allied products, and textile. Other smaller industries and miscellaneous industries contribute significant pollution. Table D shows that 451 of the industries listed have some type of waste treatment, while no treatment is provided at 536 locations. The status of treatment at 277 industries is undetermined.

Table E indicates that 164 of the known existing industrial waste treatment plants are inadequate and that the adequacy of 104 has not been determined. While the above data from table D show that 35 percent of the industries have treatment this does not reflect entirely the status of industrial waste treatment. Considering only those industries for which an estimate of organic waste load is available, about 76 percent of the organic waste load is discharged to the streams untreated and much of the treated waste requires additional treatment.

As indicated above, table E classifies municipal and industrial waste treatment plants with respect to adequacy of capacity and operation. Generally, the plants have been rated satisfactory if they are considered satisfactory for present and foreseeable future loads during critical periods or for present loads during critical periods. However, some of the latter plants which obviously will need enlargement due to increasing loads which are now foreseeable have been included in subsequent tables as required projects. The plants have been classified as satisfactory with respect to operation if the reported operation is excellent, good, or fair, during critical periods. For the reason stated above and for other reasons it should be pointed out that the data in tables C, D, and E do not necessarily agree with project requirements as shown in tables G and H. For example, treatment plants on a given stream may be satisfactory for original design conditions but may be inadequate with respect to requirements necessary to meet stream quality standards which are, as yet, undetermined. Further, some industries are listed as sources of pollution but have, at present, such a small waste load that, temporarily at least, no project is required.

The importance of good operation may be somewhat overlooked in view of the emphasis placed on obtaining installation of adequate treatment facilities. Good effluent results may frequently be obtained even with inadequate plants while, on the other hand, the best of plants requires intelligent operation and maintenance to obtain results. Attention to the requirements of good operation must hold an important place in an effective pollution abatement program.

Table F shows that 33 municipal and 160 industrial waste treatment facilities have been installed from 1946 to 1949 inclusive. Considered on the basis of waste load treated these data indicate inadequate progress when compared to the treatment facilities required. It must be realized, however, that the whole pollution abatement movement was brought to a standstill by World War II. The real progress, which includes consideration of the necessity to overcome the inertia brought about by the war, informal contacts for educational promotion and to secure cooperative interest, issuance of orders, passage of effective laws, research on treatment processes, and similar progress, presents a much more favorable picture.

One of the most important steps in promoting pollution abatement in the Ohio River Basin was the creation of the Ohio River Valley Water Sanitation Compact which became effective in June of 1948. This compact includes eight States in the basin and the provisions of the compact are carried out by a body of commissioners, including three representatives from each State and three Federal representatives. The Commission has established headquarters in Cincinnati, Ohio, and has appointed a staff to carry on its work. The operations of the Commission are too varied and extensive to describe herein in detail. They include such activities as: special industrial waste studies; review of treatment requirements at major sources of pollution, notably hearings on treatment requirements for pollution tributary to the Ohio River in the Cincinnati area; consideration of requirements in the Huntington-Ashland-Ironton area and treatment requirements in the Pittsburgh area; collaboration with industrial groups to establish programs and policies related to pollution abatement; special stream studies in collaboration with other agencies; and other work of equal importance

The Commission supplements and provides cooperation between the various State water pollution control agencies. Accomplishments by these agencies are by no means expressed in terms of actual plants built. The pollution abatement program involves education of the public with respect to pollution abatement necessity, establishment of objectives, obtaining necessary legislation, preparation and approval of plans, issuance of abatement orders, cooperative assistance to municipalities and industries, and similar work.

Pollution abatement by waste treatment plants has been supplemented in many instances by the inclusion of low flow regulation as a part of the multiple purpose uses of flood control reservoirs constructed by the Corps of Engineers and flow regulation from works constructed by other agencies. This flow regulation has widespread benefits which recur downstream from the point of release as the increased flow provides greater dilution at each source of pollution. It has been estimated that existing regulation increases the low flow in the Ohio River above the Tennessee River confluence by more than 1,200 cubic feet per second. Projects now under construction or authorized will increase this flow still more. In some locations, such as the Cumberland River Sub-Basin, special interest has been shown by State agencies in the benefits to maintenance of water quality which can be obtained through a cooperative approach to river development by Federal and local agencies.

The initial phases of the postwar pollution abatement program are well developed. The impetus has been applied and tangible results in the way of treatment facilities will be increasingly in evidence. In view of the tremendous effort necessary to attain this movement every effort should be expended to continue the progress being made. The present mobilization for defense calls for consideration of the allocation of critical materials. It can be expected that the criticalness of the situation may vary depending on circumstances now unpredictable. However, such consideration should recognize the significance of pollution abatement in preserving public health and public and industrial water supplies, all of which are vital to the national welfare.

Analysis of State Water Pollution Control Legislation[6]

The following analysis presents briefly the salient features of water pollution control legislation of the various States in the Ohio Drainage Basin. It is based on previous analyses of State legislation which were reviewed by the various States and used in the development of a Suggested State Water Pollution Control Act which was subsequently endorsed by the Council of State Governments and recommended to the States for favorable consideration.

Nine of the eleven States in the Ohio Basin--Illinois, Indiana, Kentucky, Maryland, New York, Pennsylvania, Tennessee, Virginia, and West Virginia--have established boards or commissions which have comprehensive water pollution abatement, prevention, and control powers and duties. The Illinois Sanitary Board, however, does not exercise authority over the area under the jurisdiction of the Chicago Sanitary District. Virginia has given the State Department of Health joint supervision with the State Water Pollution Control Board of sewage systems and treatment works. In Maryland, the State Board of Health has the authority to control the physical and sanitary conditions of waters as they affect public health and comfort.

Ohio has vested the State Department of Health with water pollution control prevention and abatement functions. In North Carolina, the State Board of Health and Department of Conservation and Development have water pollution control functions, and a State Stream Sanitation Committee has been established to coordinate activities of the Department of Conservation and Development and to conduct Statewide water pollution control planning.

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[6] There have been some changes in legislation, particularly in North Carolina and Tennessee, and the State of Ohio has enacted comprehensive water pollution control legislation, subsequent to preparation of this report.

Of the nine States which have established a special board or commission which has general pollution abatement powers and duties, six States--Illinois, Indiana, Kentucky, Maryland, Tennessee, and West Virginia--have the mixed type composed of ex-officio members representing State government and members representing affected interests. The Pennsylvania board is the mixed type, composed of designated ex-officio members and three members appointed by the Governor with the approval of the Senate. The New York board is composed entirely of ex-officio members representing State government, and the Virginia board is composed of members appointed by the Governor on the basis of merit.

Illinois, Indiana, Kentucky, Maryland, New York, Tennessee, and Virginia provide by statute for an executive officer or technical secretary to be in charge of the water pollution control program. In West Virginia provision is made for election of a secretary by the State Water Commission and also it is provided that the Director of the Division of Sanitary Engineering of the State Health Department shall perform such services as the Commission may request.

The water pollution control authorities of Kentucky and New York are required by statute to develop comprehensive programs for the prevention, abatement and control of water pollution. The Pennsylvania Acts are interpreted to empower and possibly require development of comprehensive programs. In Indiana, Kentucky, New York, Pennsylvania, Tennessee, and Virginia the authorities are empowered to set standards of water quality, and in Maryland the Water Pollution Control Commission may recommend such standards. New York is the only State in the basin where the State water pollution control authority is given the statutory duty to classify waters.

All States in the basin, by statute, require a permit or approval, after review of plans and specifications, for the construction of new sewage and treatment works and extensions to existing works. However, in North Carolina, permits are required only for State institutions and towns. In addition, Kentucky and Virginia require permits for any extension, modification or addition to factories, manufacturing establishments or business enterprises, the operation of which would cause an increase in the pollutional load in the water of the State.

Although the States of Maryland and West Virginia have established independent water pollution authorities, issuance of permits is the responsibility of the State Health Departments. However, in West Virginia the State Water Commission, by cooperative arrangement, approves permits for industrial waste treatment installations which are issued in the name of the State Department of Health.

All States in the basin are authorized to issue general rules and regulations relating to water pollution control. In Kentucky, Indiana, and Pennsylvania a hearing is required prior to such issuance.

Administrative orders relating to pollution abatement and control may be issued by all State water pollution authorities in the basin except North Carolina and Tennessee. Hearings are required in all these States except Pennsylvania, which however, has the statutory authority to hold hearings. Enforcement powers in Tennessee are suspended pending recommendation of the Stream Control Commission which is charged with recommending a specific program for stream pollution control during the five-year period ending June 30, 1956. The water pollution authorities of Indiana, Kentucky, New York, Tennessee, Pennsylvania and West Virginia may issue subpoenas and administer oaths, and the Maryland Water Pollution Control Commission may issue subpoenas in connection with such hearings.

In Illinois the Sanitary Water Board has no jurisdiction over wastes resulting from the production of oil and gas, such pollution being under control of the Department of Mines and Minerals. New York exempts private waters not joining any public waters. Pennsylvania exempts acid mine drainage from the operation of its water pollution control statute until the Sanitary Water Board determines that the polluting properties of such drainage are known. In Virginia, certain sanitation district commissions are exempt except for special orders of the State Water Pollution Board. The West Virginia water pollution control statutes provide, in effect, a general exemption for wastes from coal mines, including acid mine drainage, coal washery waste, and silt from strip mining.

The States of Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia, by formal agreement, executed with the specific authorization of their respective legislatures, entered into the Ohio River Valley Water Sanitation Compact, which was approved by Congress on July 11, 1940. This Compact establishes an Ohio River Valley Water Sanitation Commission which, among other things, is authorized to study pollution problems of interstate waters and tributaries within the Ohio River Valley Drainage Basin, to set standards of purity of such waters, and to order the abatement, modification or treatment of polluting discharges after notice and hearing. Such orders are effective upon the approval of a majority of the members of the Commission representing a majority of the States on the Commission, and of a majority of the Commissioners from the State in which the discharge is sought to be abated.

Table C.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	224[1] [2] [3]	224[3]	894,502[2]
Secondary	342[4]	334	2,714,193
No treatment	1,538[5] [6]	--	5,836,046[4]

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

[1] Includes 3 communities for which population served data have not been obtained.

[2] Includes data for 2 communities which have no comprehensive public sewerage systems. These 2 communities have an estimated population of 2,795.

[3] In some instances a single municipality is served by more than one treatment plant; in others a single treatment plant serves more than one community.

[4] Includes 6 communities for which population data have not been obtained.

[5] Includes 73 communities for which population served data have not been obtained, 53 of which have no comprehensive public sewerage system.

[6] Includes data for 545 communities having no comprehensive public sewerage systems, but for which population data are available. These 545 communities have an estimated combined population of 325,159.

Table D. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	402	187	197	18
Textile mill products......	19	3	12	4
Lumber and wood products...	13	4	7	2
Paper and allied products..	47	10	34	3
Chemical and allied products.................	86	30	30	26
Products of petroleum and coal......................	77	56	14	7
Rubber products............	4	1	3	0
Leather and leather products.................	20	13	6	1
Primary metal industries...	101	47	42	12
Fabricated metal products..	147	36	102	9
Coal washing...............	178	11	16	151
Other mining industries....	11	5	4	2
Miscellaneous..............	123	34	57	32
Undetermined...............	36	14	12	10
Totals....................	1,265	452	536	277

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	558*	341**	159	58	393	98	67
Industrial	451	183	164	104	263	77	112

*558 treatment plants serve 566 municipalities or communities.

**Some of the plants which are listed as satisfactory in this table are included in table G as undetermined with respect to project requirements. The reason for this is that the existing plants are satisfactory on the basis of original design but additional facilities may be required following establishment of water quality objectives by State agencies having jurisdiction. Also, some plants are listed as having satisfactory treatment but are listed as a project required in table G because of foreseeable pollution load increases.

Table F. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	1	Undetermined	11	Undetermined
1947	2	49,200	34	Undetermined
1948	12	26,500[1]	49[2]	Undetermined[3]
1949	18	87,543[4]	66	2,620[5]

[1] Includes 8 plants, one of which serves an estimated population of 500 but for which design population has not been determined. Design populations are undetermined for the four remaining plants.

[2] Includes one installation at an industrial plant for treating sanitary sewage only, and two plants for the treatment of inorganic wastes.

[3] Population equivalent unknown. Volume of wastes amounts to more than 10 M.G.D.

[4] Includes 14 plants. Design populations are undetermined for the four remaining plants.

[5] Includes 3 plants. One plant treats inorganic wastes and one plant with an undetermined population equivalent treats 4,400 gallons of wastes per day. The amount of waste treated by the 61 remaining plants is undetermined.

POLLUTION PREVENTION MEASURES REQUIRED

Table G lists the municipal and industrial waste treatment requirements in the basin as reported by the State water pollution control agencies. There are 2,104 locations, classed as municipalities, which are listed as contributing pollution to the streams. This classification includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers. Of these, 327, or 15.5 percent of the total number are listed under "No Project Required" for waste treatment. From a population standpoint, approximately 12 percent of the population contributing to the pollution load from the listed municipalities is located in these 327 municipalities. There are 1,777 locations listed as either requiring projects for pollution abatement or listed as sources of pollution for which requirements have not been determined. Classified as to size on the basis of the 1940 populations, 408 of these had populations in excess of 2,500; 451 had populations from 1,001 through 2,500; 488 had populations from 501 through 1,000; and 430 had populations less than 500. Reported waste treatment requirements for municipalities include: 911 new plants; 132 enlargements or additions to existing plants; and replacement of 39 existing plants. These represent 43 percent, 6.2 percent, and 1.8 percent, respectively, of the total number of municipal sources of pollution. On a population basis the percentage values are 57, 21, and 2.5, respectively. The requirements at 695 locations, or 32 percent, have not been established. These latter locations include many small communities, 499 of which have no comprehensive public sewerage system. On a population basis these 695 locations represent only about 7 percent of the total population listed as contributing pollution to the streams.

Of the 1,264 sources of industrial pollution listed, only 231, or 18 percent, are classified as requiring no project for waste treatment. Established treatment requirements include: 539 new plants; 108 enlargements or additions to existing plants; and 33 replacements of existing plants. These represent, respectively, 43 percent, 9 percent, and 3 percent of the total number of industrial sources of pollution.

The requirements indicated by table G are not necessarily in agreement with requirements which may be inferred from data in the preceding tables, nor in agreement with the number of separate projects which will be required. Table E indicates treatment plants which are adequate or inadequate. These plants may serve more than one municipality or one municipality may be served by more than one plant. The list in table G is based on the requirements of municipalities without reference to the number of treatment plants involved. Some municipalities listed in table E as satisfactory for present loading or existing stream standards are listed in table G and in the sub-basin tables I as requiring a project to meet requirements of foreseeable population growths, or as "undetermined" because of possible changes in stream classification. In many instances industries are listed in table G as requiring new plants even though, as indicated in other tables, the presence or absence of partial ineffective treatment has not been determined. Some industries and small municipalities, which now have treatment, are listed as requiring no projects or listed under undetermined requirements because, under present conditions, their effects on the streams do not clearly indicate a need for treatment. Combinations of multiple sources of pollution for treatment at central points will affect the number of projects required.

Some sanitary districts have been formed and these contemplate treatment of wastes from several municipalities in one treatment plant. Examples are the Allegheny County Sanitary District in Pennsylvania and the Sanitary District composed of municipalities in northern Kenton and Campbell counties in Kentucky. Undoubtedly many industries will connect to municipal sewage treatment plants, while others may obtain effective pollution abatement by changes in plant processes.

Table H indicates the status of treatment works projects required to abate pollution. The first six steps indicated in the table are listed in the order of progress of projects to the point where adequate treatment is provided and each project is listed only once. This method of listing does not indicate the total number of abatement orders issued by State water pollution control agencies. For example, all of the sources of pollution in Pennsylvania which are listed by name in tables I for the sub-basins have received abatement orders. Also, the table does not fully indicate action being taken since some of the States are making considerable progress through informal contacts and educational programs. In particular, reports from Ohio show numerous instances of informal contacts with industries, many of which may result in pollution abatement without the necessity of formal orders. The tables I in the various sub-basin sections in Part II of the report list the project requirements at locations where action is required to abate pollution. It is to be understood that abatement requirements may be met by other means than listed in the tables. For example, industrial plants listed as requiring new treatment plants may meet requirements by connection to municipal systems or by process changes which effectively correct the problem.

No formal action has been taken to abate pollution at 336, or 16 percent, of the municipal sources of pollution. Corrective action has been initiated at 497, or 24 percent. The status at 944 locations, or 45 percent, has not been determined.

No formal action has been taken to abate pollution at 531, or 42 percent, of the 1,264 industrial sources of pollution. Definite corrective action has been initiated at 212 locations, or 17 percent. The status of 290 sources, or 23 percent, has not been determined. Ten industries are listed as awaiting financing. These industries have made plans to connect to municipal systems which are now awaiting financing.

Continued attention should be given to the pollution abatement benefits from low flow regulation which can be obtained in conjunction with multiple-purpose reservoirs which will be constructed as a part of the comprehensive water resources development. Low flow regulation should not be considered as a replacement for waste treatment at the source, but rather as a valuable supplement to such treatment in order to obtain a reduction in capital costs for higher degrees of treatment which might otherwise be required to protect downstream water uses or, in many instances, to obtain water quality not obtainable by known or practicable methods of treatment. In addition to direct benefits from flow regulation, due to reduction of the degree of treatment required at specific locations in order to obtain minimum water quality conditions, there are other substantial benefits. These include provision of a margin of safety for future municipal and industrial growth and benefits from a resultant water quality which is better than the bare minimum acceptable quality. These latter benefits should always be taken into consideration in the development of the water resources of the basin. Detailed studies and inter-agency coordination will be required to develop a comprehensive plan for flow regulation in order to obtain a logical and most beneficial development.

Continued attention should be given to the need for effective State legislation to promote an effective pollution abatement program. This need is recognized and action is being taken or has been taken by several of the States, along with the cooperation of the Ohio River Valley Water Sanitation Commission, to promote improved legislation. The State of Kentucky passed legislation in 1950 which was designed to make the pollution abatement law more effective. West Virginia has under consideration improvements in legislation for that State. Ohio, Illinois, and New York have also made improvements in the laws related to pollution abatement; however, certain weaknesses still exist in some statutes. In Tennessee the authority of the control agency has been temporarily suspended by legislative action pending a study and report by a special study commission.[7] In Illinois, pollution resulting from the production of oil and gas is outside the authority of the water pollution control agency. In West Virginia, pollution resulting from the production of coal is, in effect, exempt from State water pollution agency control. Control of acid mine drainage remains a problem in much of the basin. From the standpoint of comprehensive water pollution control legislation, the State of Ohio has the least effective law of all the States in the basin.[8] Some weaknesses in the enforcement provisions of the existing statute have also become apparent. The State water pollution control program in Ohio would be materially strengthened by enactment of a comprehensive water pollution control act similar to that recommended by the Public Health Service and approved by the Council of State Governments. North Carolina has no comprehensive water pollution control legislation.[9]

Even after present obvious legislative needs have been met it is highly probable that new developments will create added needs. At the present time a decision on the legality of the interstate compact in the basin by the West Virginia State Supreme Court is being reviewed by the Supreme Court of the United States.[10] This emphasizes the need for continued attention to legislative requirements.

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[7] Revised by changes in legislation subsequent to the preparation of this report.

[8] Comprehensive water pollution control legislation was enacted by the Ohio legislature in June 1951.

[9] Changes have been made in North Carolina legislation subsequent to the preparation of this report.

[10] The Supreme Court of the United States has rendered a decision upholding the interstate compact.

Further legislation or policies need to be established with respect to operation of waste treatment plants. Efficient operation of treatment plants is of paramount importance to pollution abatement. Systematic reports are necessary to demonstrate that proper operation is being obtained. There is need for promoting fuller recognition of appropriation requirements of State water pollution control agencies to permit adequate enforcement of abatement requirements, supervision of operation, and field work necessary to establish pollution conditions and objectives.

Even assuming that adequate legislation is obtained, effective stream pollution abatement will still require the support of public opinion. An informational program is needed to inform the public of the advantages of, and obligations to provide, pollution abatement. Distribution of information to the individual on the costs for sewage treatment as compared to the benefits would also be helpful. The annual amortization and operating cost per capita for sewage treatment, exclusive of the collection and interceptor sewers, for the average municipality is in the order of one fifth to one tenth the cost of cigarettes for the average smoker. A comparison of sewage treatment cost with other somewhat related commonplace items, such as garbage removal, soap (a comparatively costly item) or even toilet paper, the costs of which are met without too much complaint, show that the objectives justify the expense.

Despite the fact that the cost per capita for sewage treatment is one of the smallest items in the average family's budget, the cost of sewage treatment plants and interceptor sewers is still of major concern in promoting effective pollution abatement. Also, cost of industrial waste treatment is important in competitive enterprises. An accurate estimate of the total cost for required waste treatment projects in the basin would require numerous data which are not now available. The degree of required treatment is an important cost factor. The degrees of treatment required have not been determined for a large number of locations and the effects of low flow regulation on treatment costs have not been fully considered. Interceptor sewers are costly and cause wide variation from average costs at different locations. Research on waste treatment for industrial waste is required and the cost of treatment is dependent on the results of this research. The solution for the acid mine drainage problem is not yet known. With these serious limitations on accuracy the estimate of cost for pollution abatement in the basin will reflect only the general magnitude of the stream pollution abatement program.

Based on a limited amount of data from recent estimates of cost for sewage treatment plants for which final plans have been prepared, and on pre-war cost curves, adjusted to the average 1949 cost index, the estimated capital cost of required municipal treatment projects, including allowance for interceptor sewers, is about $310,000,000. The estimate of cost for providing facilities to treat organic industrial waste which is discharged directly to watercourses (i.e. not connected to municipal systems) is between $40,000,000 and $80,000,000, exclusive of process piping changes which may be required. This estimate is subject to a wide variation, depending on the extent to which it will be found feasible to collect and treat industrial wastes in municipal systems. Additional expenditures will be required for inorganic waste treatment and for correcting the acid mine drainage problems. The magnitude of these expenditures cannot be approximated with any degree of accuracy because of the lack of information on the extent of the wastes and on satisfactory treatment methods. The magnitude of the capital expenditures required for pollution abatement projects in the basin is, therefore, in the neighborhood of $350,000,000 to $400,000,000, plus requirements for inorganic wastes and acid mine drainage. The average per capita annual charges required to amortize the capital costs of municipal projects in 20 years at 3 percent interest would be a little over $2.00.

The above estimates of cost are based on present known requirements plus an allowance for those municipalities having comprehensive sewerage systems for which the project requirements have not definitely been determined. The range in limits of the estimate for organic industrial waste treatment is intended to include those industries for which up to date information on loads is unavailable. The estimates do not include allowances for those communities having no comprehensive public sewerage systems for which project requirements are undetermined.

Recognizing that the expenditures for pollution abatement projects will take place over a number of years it is to be expected that certain factors will tend to increase the cost. These factors include additional annual obsolescence and rehabilitation requirements, needs of communities installing new sewage collecting systems, normal population increases, and industrial expansion.

Table G. Requirements for municipal and industrial waste treatment plants*

Requirements**	Municipal		Industrial
	Number ***[1]	Population served by facilities	Number ***[1]
New plant	911[2,3]	5,393,455[3]	539
Enlargement or additions to existing plant	132[4,5,6]	2,002,184[4]	108
Replace existing plant	39[7]	241,250	33
No project required	327[8,11]	1,143,273[9]	231[10]
Undetermined	695[11,12]	664,579[12]	353

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**For a listing of individual project needs refer to tables I included in the Sub-basin discussions which follow the main part of the report.

***The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by previous tables. See discussion under "Pollution Prevention Measures Required."

[2] Includes 7 communities for which the population data have not been determined. Two of these have no comprehensive public sewerage systems.

[3] Includes data for 90 communities having no comprehensive public sewerage systems, but which have an estimated combined population of 84,223.

[4] Includes data for 2 communities having no comprehensive public sewerage systems. These communities have an estimated combined population of 2,795.

[5] Includes a military post served by treatment facilities at Dayton. The population of the post is not available.

[6] 124 treatment plants are now serving these 132 municipalities.

[7] 38 treatment plants are now serving these 39 municipalities.

[8] Includes 7 sources for which the population served has not been determined. One of these has no comprehensive public sewerage system.

[9] Includes data for 6 communities which have no comprehensive public sewerage systems. These communities have an estimated combined population of 2,430.

[10] Includes some industries listed in table E as "Undetermined". Apparently no projects will be required at some locations, although final determinations of requirements have not been made.

[11] Includes 67 communities for which population data have not been determined. Fifty of these have no comprehensive public sewerage systems.

[12] Includes 449 communities having no comprehensive public sewerage systems, but for which population data are available. These 449 communities have an estimated combined population of 238,506.

Table H. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	336	531
Abatement ordered	31	28
Plans under preparation	181	130
Final plans approved	244	30
Construction awaiting financing	6[1]	10[2]
Under construction	33[3]	14
Status undetermined	946	290

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

[1] Includes one institution which will connect to treatment plant at Nashville, Tenn.

[2] Includes 5 industries which will connect to the Nashville treatment plant, and one industry which will connect to the Watertown treatment plant.

[3] Additions being made to one plant at Columbus, Ohio, to serve Columbus and seven other adjoining municipalities or population centers.

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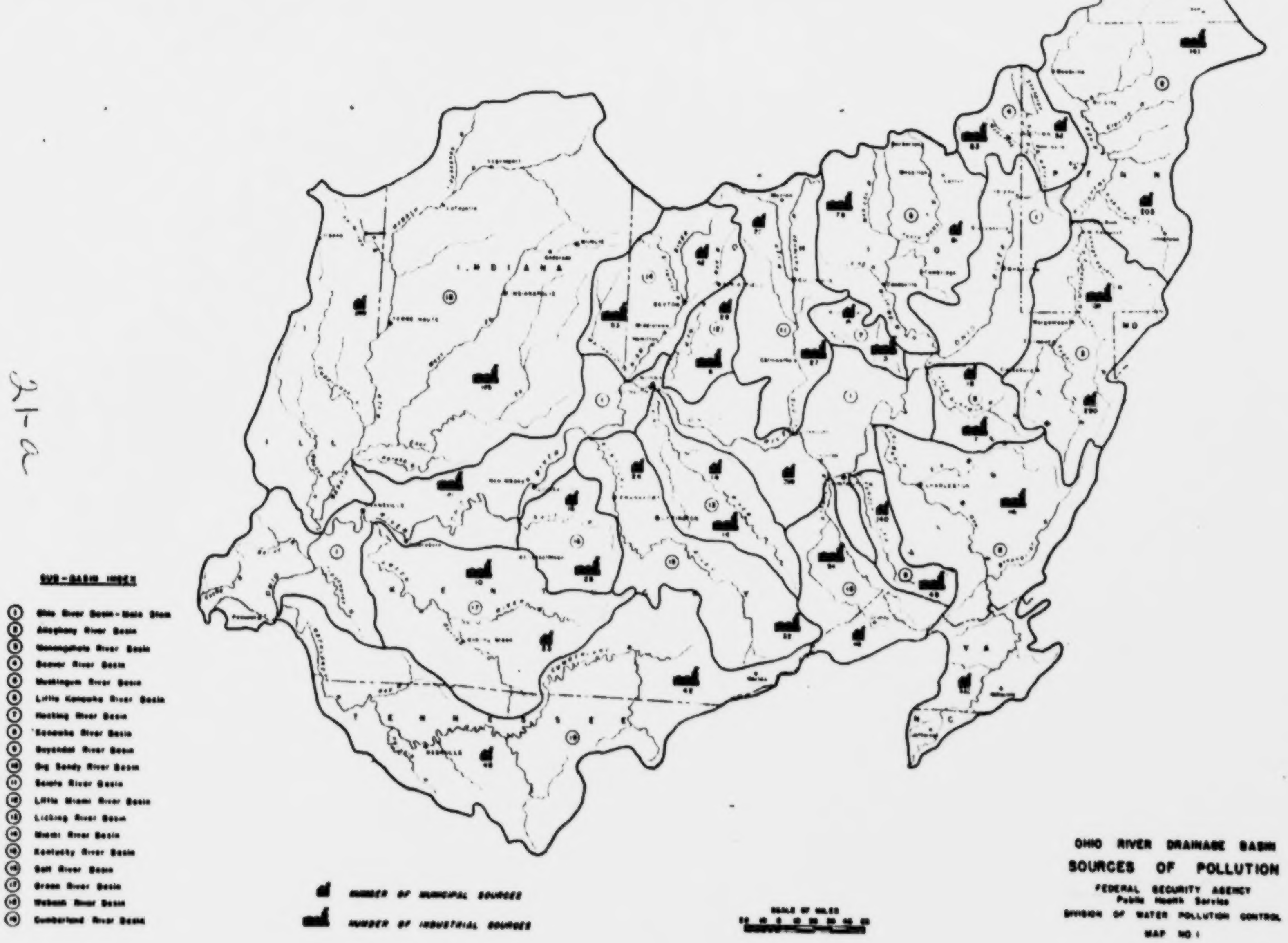
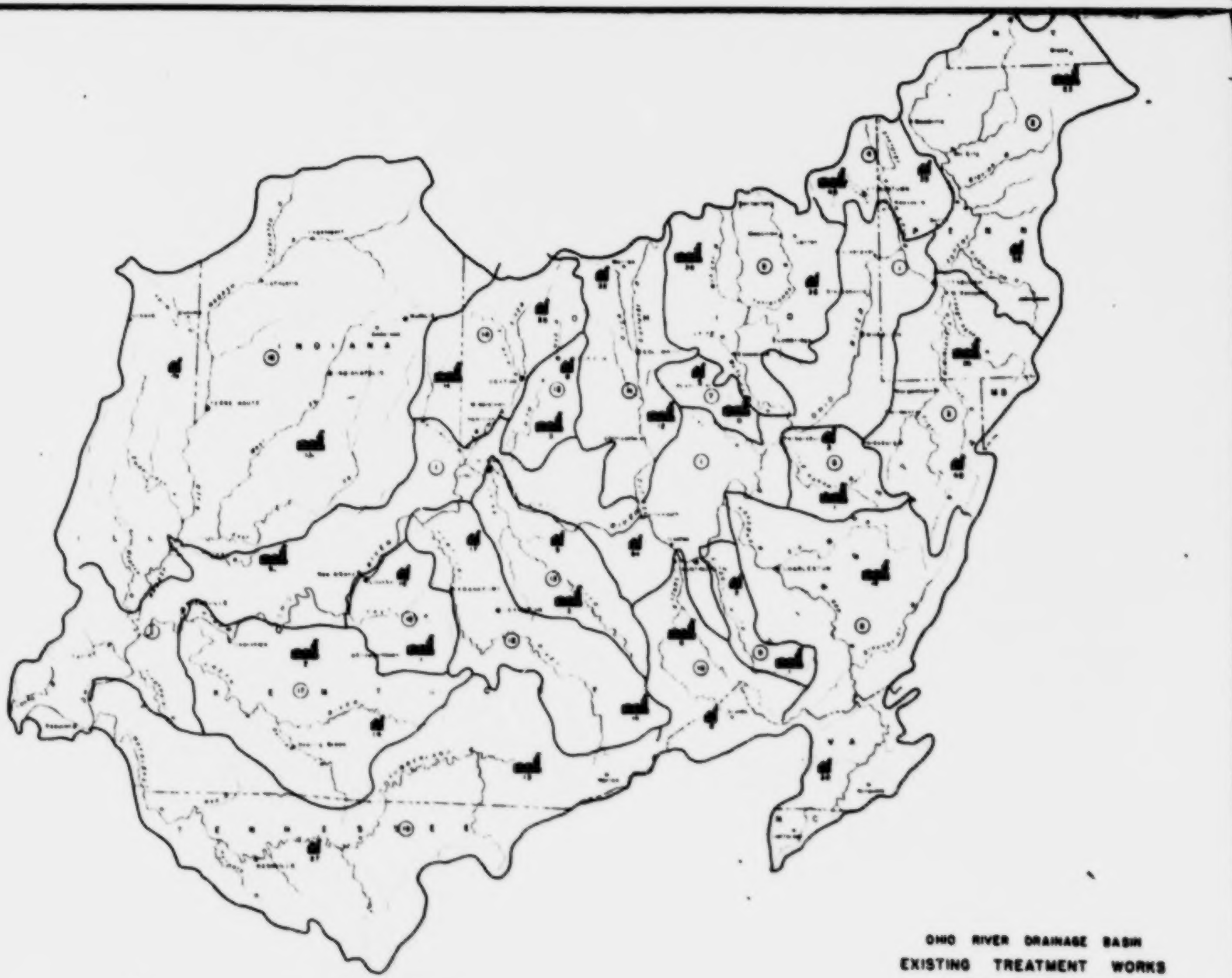


OHIO RIVER DRAINAGE BASIN
SOURCES OF POLLUTION
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO 1



21-7

SUB-BASIN INDEX

- ① Ohio River Basin—Main Stem
- ② Allegheny River Basin
- ③ Monongahela River Basin
- ④ Beaver River Basin
- ⑤ Muskingum River Basin
- ⑥ Little Kanawha River Basin
- ⑦ Hocking River Basin
- ⑧ Kanawha River Basin
- ⑨ Guyandot River Basin
- ⑩ Big Sandy River Basin
- ⑪ Scioto River Basin
- ⑫ Little Miami River Basin
- ⑬ Licking River Basin
- ⑭ Miami River Basin
- ⑮ Kentucky River Basin
- ⑯ Salt River Basin
- ⑰ Green River Basin
- ⑱ Wabash River Basin
- ⑲ Cumberland River Basin

NUMBER OF EXISTING MUNICIPAL TREATMENT WORKS

NUMBER OF EXISTING INDUSTRIAL TREATMENT WORKS

SCALE OF MILES
50 40 0 10 20 30 40 50

OHIO RIVER DRAINAGE BASIN

EXISTING TREATMENT WORKS

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO 2

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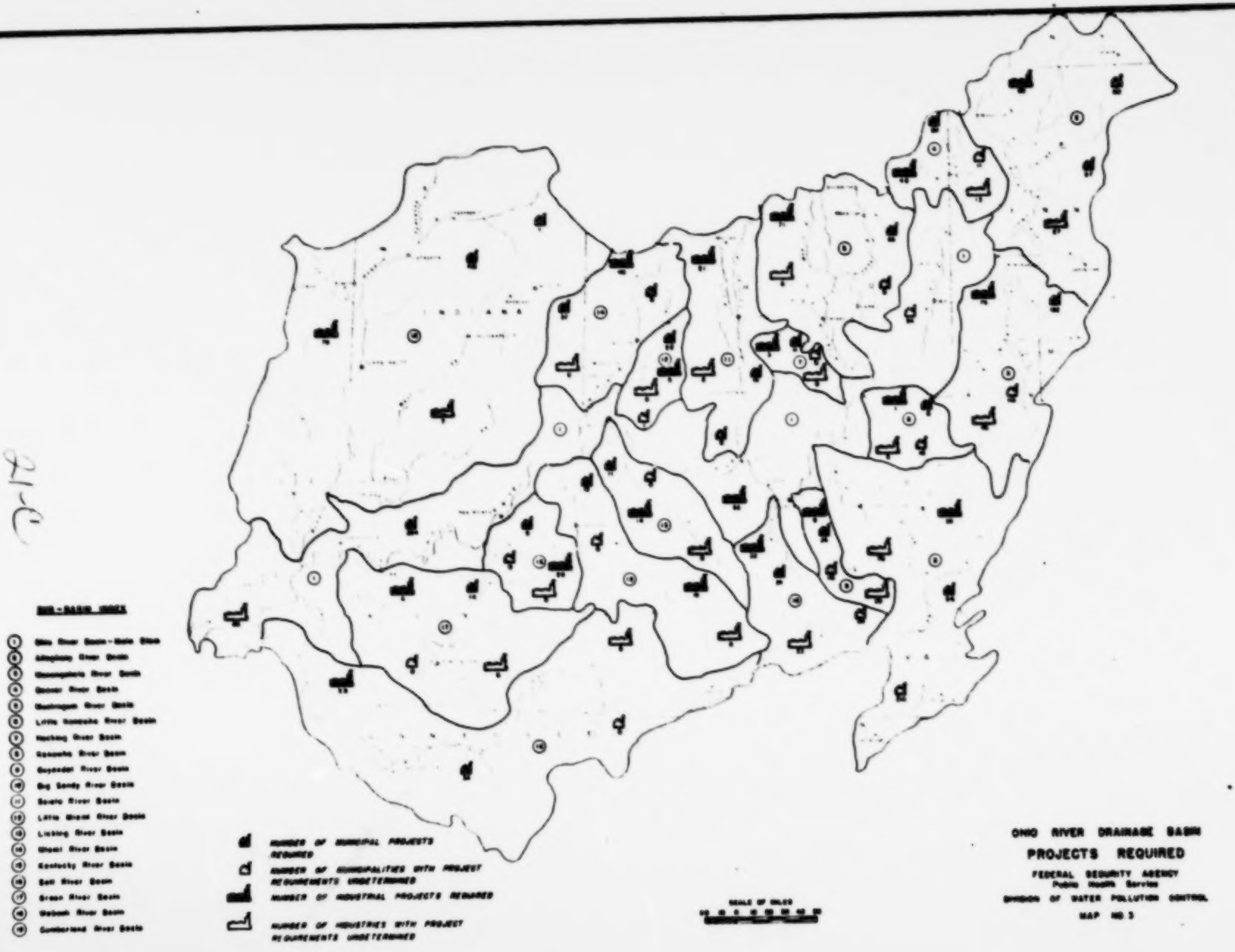
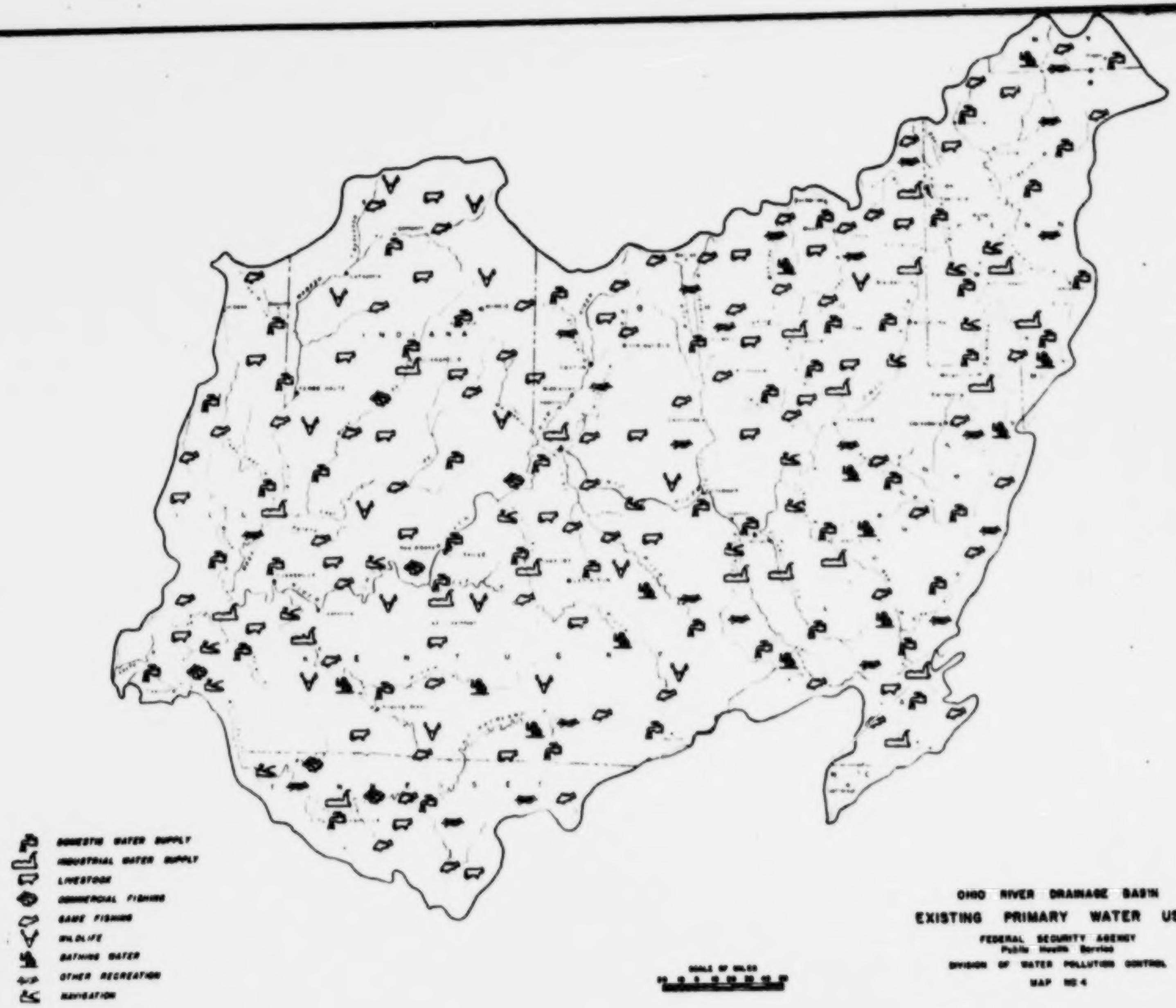

OHIO RIVER DRAINAGE BASIN
PROJECTS REQUIRED
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO 3
SCALE OF MILES
SUB-BASIN INDEX
① Ohio River Basin-Main Stem
② Allegheny River Basin
③ Monongahela River Basin
④ Beaver River Basin
⑤ Muskingum River Basin
⑥ Little Kanawha River Basin
⑦ Hocking River Basin
⑧ Kanawha River Basin
⑨ Guyandot River Basin
⑩ Big Sandy River Basin
⑪ Scioto River Basin
⑫ Little Miami River Basin
⑬ Licking River Basin
⑭ Miami River Basin
⑮ Kentucky River Basin
⑯ Salt River Basin
⑰ Green River Basin
⑱ Wabash River Basin
⑲ Cumberland River Basin
NUMBER OF MUNICIPAL PROJECTS REQUIRED
NUMBER OF MUNICIPALITIES WITH PROJECT REQUIREMENTS UNDETERMINED
NUMBER OF INDUSTRIAL PROJECTS REQUIRED
NUMBER OF INDUSTRIES WITH PROJECT REQUIREMENTS UNDETERMINED
INDIANA

21-C



OHIO RIVER DRAINAGE BASIN

EXISTING PRIMARY WATER USES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO 4

21-d

SUB-BASIN REPORTS

OHIO RIVER MAIN STEM AND MINOR TRIBUTARIES SUB-BASIN

General Description

The main stem of the Ohio River originates at the confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pa. From this point the river flows in a northwesterly direction through Pennsylvania for about 25 miles, then turns westward to East Liverpool Ohio, located near the Ohio-Pennsylvania border. The river forms the entire eastern and southern boundary of Ohio, below East Liverpool, flowing in a generally south and southwesterly direction between Ohio and West Virginia, and in a generally west-northwesterly direction between Ohio and Kentucky. At the Ohio-Indiana border, the river again takes a generally southwesterly course, forming the southern boundaries of Indiana and Illinois and the northern boundary of Kentucky, and finally joins the Mississippi River at Cairo, Ill., 981 miles below its point of origin. There are 18 major tributaries to the Ohio River which have been included in this report as separate sub-basins. One other tributary, the Tennessee River, is considered as a major drainage basin and is included in a separate report. All other small tributaries and the areas draining directly to the Ohio River are included under this sub-basin, the total area of which is about 23,780 square miles. The river originates in the Appalachian Plateau area and flows through that physiographic region for about one-third of its length. From that point on downstream the area to the north of the river is mostly composed of the glaciated area of the Interior Plains, although a fringe area along the river and a large section in southern Indiana is unglaciated. The area to the southwest is included in the Interior Plateau province of the Interior Plains and is not glaciated.

Economic Development

The development of the area along the Ohio River preceded the development in much of the area along the tributaries. Most of the Ohio River cities are relatively old and, due to their location with respect to transportation facilities, are important from the standpoint of commerce. Steel production and metal fabricating plants are the outstanding industries in the sub-basin. Other important industries include food processing, textile, chemical, petroleum and coal products, paper, machine tool, sand and gravel industries. Agriculture is also an important activity in the area.

Rainfall and Runoff

The axis of the main stem of the Ohio River lies in the general path of the moisture-bearing low pressure formations from the Gulf of Mexico which results in decreasing average annual precipitation from the mouth of the river to the headwaters. The annual average varies from about 52 inches at the mouth to about 36 inches at the headwaters. The average monthly precipitation values show slightly greater rainfall in the spring and summer months than in the fall and winter months. The variation from the monthly and annual averages is quite large and in extreme instances the annual precipitation may be as low as 50 percent of the average in some areas. The runoff to the main stem of the Ohio River is governed by the runoff from the major tributaries, and varies between wide extremes. The maximum recorded discharge at Metropolis, Ill., was 1,780,000 cubic feet per second and occurred in 1937. The maximum discharge during the same year at Cincinnati, Ohio, was 894,000 cubic feet per second. The minimum mean daily flow at Cincinnati, Ohio, occurred in 1930 and was estimated at about 2,850 cubic feet per second. The critical flows are now affected by regulation from multiple-purpose reservoirs, including those in the Tennessee River Basin. The minimum flow increase above the confluence of the Tennessee and Ohio Rivers during critical periods, from regulation by reservoirs placed in operation after 1938, is estimated at about 1,200 cubic feet per second.

Major River Developments

The entire main stem of the Ohio River has been developed for navigation. The navigation structures include 46 locks and dams designed to provide a minimum channel depth of 9 feet. There is only one hydroelectric power development at present, the capacity of which is in excess of 80,000 kilowatts. Studies are currently being made by the Corps of Engineers on a plan to increase the minimum channel depth to 12 feet, which will involve replacement of some of the comparatively low dams with high dams. Three dams included in this plan are authorized for construction. The navigation system is one of the most used systems in the world and has been an important factor in the economic development of the sub-basin.

Population

The 1940 population in the sub-basin was about 3,601,600. Of this total, the 1940 population in municipalities and other population centers now listed by State water pollution control agencies as sources of pollution was about 2,406,400.

Water Uses

The waters of the main stem of the Ohio River are used extensively as sources for domestic and industrial water supplies, for waste disposal and for navigation. The main stream and minor tributaries are used to a considerable extent for recreation and sport fishing. The lower river is also used to some extent for commercial fishing. Available data indicate that 75 water supplies, serving a population of about 1,810,000 in 112 communities, use the Ohio River or its minor tributaries as sources of raw water. Of this total population served by surface supplies, more than 90 percent is served by supplies which use the waters of the main stream as a source. A number of communities, notably Pittsburgh, Catlettsburg, and communities receiving water from these cities which are considered sources of pollution in this section of the report, are served by water supplies which use streams of other sub-basins as sources. Water supply data for these communities are considered in the sections covering the sub-basins which contain the source streams and are not included in the above figures.

Many industries use the stream as a source of water. Steel mills along the upper river use great quantities of water, principally for cooling. The water used for this purpose is returned to the stream unchanged except for its increased temperature.

The waters of the sub-basin are used for final waste disposal by the many cities, towns and industries located in the area. This use will continue to be of tremendous economic importance but must be regulated to resolve the conflicts with other water uses.

The Ohio River is one of the major freight-carrying waterways of the Nation. The entire stream has been developed for navigation and many millions of tons of freight are carried on it each year.

The Ohio River is used extensively for recreation. Numerous boat and yacht clubs use the waters, and there is considerable use for bathing at some locations. The main stream is used to a considerable extent for sport fishing, although its minor tributaries, particularly those near large cities, are more extensively used for this purpose.

None of the minor tributaries of the Ohio have been developed for navigation.

Sources of Pollution

Domestic wastes and wastes from connected industries are discharged to the streams of the sub-basin through the sewers of 298 municipalities or other population centers listed as contributing significant amounts of pollution. In addition, industrial wastes are discharged to the streams from 197 industries which do not have connections to municipal sewerage systems. Wastes from 209 municipalities, with a combined population served of about 2,235,000, have a B.O.D. population equivalent of about 4,033,000. Data concerning the B.O.D. population equivalent for wastes from 59 municipalities, having a combined population served of about 222,000, are not available. No data are available concerning populations of 30 population centers.

Forty industrial plants produce organic wastes with a B.O.D. population equivalent of about 389,000. The population equivalent of organic wastes from 39 more plants have not been determined. Twenty-four of the 79 plants producing organic wastes also produce inorganic wastes. Wastes from 102 industrial plants are inorganic only, and the types of wastes produced by 16 have not been determined.

Inorganic wastes received by the river include waste pickle liquor from the steel mills. Most of this waste, equivalent to many tons of acid each day, is discharged to the upper portion of the river. Acid mine drainage discharged to the streams of the sub-basin, plus the residual effects of mine drainage discharged in the other major tributaries, cause damaging acid conditions in the upper portion of the main stem.

Effects of Pollution on Water Uses

Wastes discharged to the Ohio River and its tributaries cause heavy pollution at the intakes of many of the domestic water supplies which use the river as a source. Considerable expense has been incurred in some localities in the improvement of water treatment plants to handle the heavy bacterial loadings and to improve taste and odor characteristics of the finished water. Bacterial pollution is so great in some locations as to exceed recognized upper safe limits as a source of municipal water supply. The situation is especially critical below Pittsburgh, in the Huntington-

Ashland-Ironton area, at Cincinnati, and below Louisville and Evansville.

Acidity in the Ohio River is due to the effect of mine drainage and steel mill wastes. Of the two, mine drainage is by far the greater source. This pollution is the cause of very substantial monetary loss each year from corrosion damage to navigation equipment, water supply facilities, and other water use structures and equipment. The major portion of this damage is limited to the upper 10 or 15 percent of the river. Acid conditions sufficiently strong to be considered detrimental to fish life have been observed on several occasions along the upper main stem.

Organic pollution also causes considerable damage to fish life through the mediums of oxygen reduction, toxic materials and the deposition of sludge beds which interfere with the normal spawning process. The decrease in fish population and the nuisance conditions caused by pollution have drastically reduced the recreational value of the Ohio River.

Treatment Provided

Treatment is provided for the domestic wastes from 62 of the 298 municipalities which discharge wastes to the main stem or minor tributaries of the Ohio River. Secondary treatment is provided for wastes from a population of about 118,000 in 36 municipalities, and primary treatment is provided for the wastes from a population of about 33,600 in 23 municipalities. Population data are not available for two more communities which provide secondary treatment and one more community which provides primary treatment. No waste treatment is provided for 208 communities having a total sewered population of about 2,305,000, and 28 communities for which data concerning the population served by sewers is not available.

Of the 197 industrial plants which discharge wastes to the watercourse, 52 provide some measure of waste treatment. Seventy-five industrial plants have no waste treatment facilities and the waste treatment status at the remaining 70 plants has not been determined.

Tables C_1, D_1 and E_1 list data relative to waste treatment in the main stem valley.

Treatment Plants Required

Table G_1 contains summary data relative to treatment plant requirements for pollution sources along the main stem or minor tributaries of the Ohio. Table I_1 lists individual municipal and industrial projects known to be needed. New treatment plants are required at 189 municipal sources of pollution. These locations include some 90 percent of the population which contributes wastes to the streams. Thirteen municipalities require enlargement of or additions to existing treatment plants, two require replacement of existing facilities, and the requirements at 54 have not been determined. Eighty industrial plants require new treatment facilities, 10 require enlargement of or additions to existing facilities, one requires replacement of an existing plant, and the requirements at 88 have not been determined. Forty municipalities and 18 industrial plants require no waste treatment plant projects.

Table H_1 indicates the status of treatment works projects required to abate pollution. Special emphasis has been placed on action to obtain abatement at the major sources of pollution by water pollution control agencies.

Table A_1. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	209[1]	2,235,213	4,032,963
Having population data available (Data on pollution load to watercourse incomplete or not available)	89[2] [3]	221,422[2]	Not applicable
Total	298	2,456,635	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes data for one community for which the population served has not been determined.

[2] Includes data for six communities having no comprehensive public sewerage system. These six communities have an estimated combined population of 6,809.

[3] Includes 30 communities for which population data have not been determined. Of these, 25 have no comprehensive public sewerage system.

Of particular interest is the hearing held by the Ohio River Valley Water Sanitation Commission on treatment requirements for waste discharged to the main stem in the Cincinnati area and the review of requirements and support to State agencies in the Pittsburgh area, the Huntington-Ashland-Ironton area, and the Louisville area.

Table B_1. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	40**	389,102
Producing organic wastes	39[1]	Undetermined
Producing inorganic wastes	126	Not applicable
Producing wastes of undetermined type	16	Undetermined
Total	197[2]	--

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 16 plants also producing inorganic wastes.

[1] Includes 8 plants also producing inorganic wastes.

[2] Total adjusted to correct for duplication noted in footnote marked thus, ** and [1].

Tabular Data

Tables A_1 through I_1 present data relative to water pollution along the main stem and minor tributaries of the Ohio River.

Table C_1.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	24	25[1]	33,621
Secondary	38	39[2]	118,402
No treatment	236[3 4 5]	--	2,304,612[3 5]

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

[1] Includes one treatment plant in a community for which the population data have not been determined.

[2] Includes two treatment plants in two communities for which the population data have not been determined.

[3] Ashland, Fort Thomas, and Park Hills, all in Kentucky, have small treatment plants which serve only minor portions of their respective populations, and are therefore included in the no treatment category.

[4] Includes 28 communities for which population data have not been determined. Of these, 25 have no comprehensive public sewerage systems.

[5] Includes 6 communities having no comprehensive public sewerage system, but for which population data are available. These 6 communities have an estimated combined population of 6,809.

Table D_1. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	33	13	15	5
Textile mill products......	4	—	1	3
Lumber and wood products...	2	0	2	0
Paper and allied products..	5	—	2	3
Chemical and allied products..................	19	5	6	8
Products of petroleum and coal.................	14	9	2	3
Leather and leather products..................	1	1	0	0
Primary metal industries...	40	9	21	10
Fabricated metal products..	31	5	20	6
Coal washery...............	11	3	1	7
Miscellaneous..............	37	7	5	25
Totals....................	197	52	75	70

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_1. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	64*	43	12	9	45	10	9
Industrial	52	18	11	23	25	3	24

*64 treatment plants serving 62 municipalities.

Table F_1. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	1	Undetermined
1947	0	—	4	Undetermined
1948	4	3,500*	6	Undetermined
1949	3	10,160	4	Undetermined

*Includes estimated population of 500 served by a treatment plant for which the design population has not been obtained.

Table G_1. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**[1]	Population served by facilities	Number**[1]
New plant	189[2,3]	2,220,891[2]	80
Enlargement or additions to existing plant	13	51,268	12
Replace existing plant	2	16,800	1
No project required	40[4]	96,343	18
Undetermined	54[5]	71,333	88

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by previous tables. See discussion under "Pollution Prevention Measures Required," Part I of the report.

[2] Includes data for 31 communities in Pennsylvania which have entered into an agreement with the Allegheny County Sanitary Authority to treat sewage at a central plant and 12 communities which will be included in the four proposed plants for the city of Cincinnati. Also includes 6 communities having an estimated combined population of 6,809 and having no comprehensive public sewerage system.

[3] Includes 2 communities for which the populations served have not been determined.

[4] Includes one community for which the population served has not been determined.

[5] Includes 28 communities for which population data have not been determined. Of these, 25 have no comprehensive public sewerage systems.

Table H_1. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	62	71
Abatement ordered	13	1
Plans under preparation	44	20
Final plans approved	65	6
Construction awaiting financing	0	0
Under construction	4	4
Status undetermined	70	77

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_1. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Pennsylvania:			
Lockhart Iron & Steel Company	—	New plant	Plans under preparation
Pressed Steel Car Co.	—	New plant	Plans under preparation
Pittsburgh Screw & Bolt Company (A)	—	New plant	Plans under preparation
Vulcan Detinning Co.	—	Replacement	Abatement ordered
Pittsburgh Screw & Bolt Company (B)	—	New plant	Plans under preparation
Pittsburgh Forgings Co.	—	New plant	Plans under preparation
Russet, Burdsall & Ward	—	New plant	Plans under preparation
Wykoff Drawn Steel Co.	—	New plant	Under construction
National Supply Co.	—	New plant	Final plans approved
Jones & Laughlin Steel Company	—	New plant	Under construction
Freedom Oil Company	—	New plant	Plans under preparation
Colonial Steel Company	—	New plant	Plans under preparation
Pittsburgh Tube Co.	—	New plant	Plans under preparation
Pittsburgh Tool Steel Wire Company	—	New plant	Plans under preparation
Pittsburgh Crucible Steel Company	—	New plant	Plans under preparation Various units completed
Jessup Steel Company	—	New plant	Plans under preparation
Flannery Bolt Company	—	New plant	Plans under preparation
Vanadium Corp. of America	—	New plant	Final plans approved
Universal Cyclops Steel Company	—	New plant	Final plans approved
Columbia Steel & Shafting Company	—	New plant	Final plans approved
Falk & Company	—	New plant	Final plans approved
American Cyanamid & Chemical Corporation	—	New plant	Final plans approved
Prest-O-Lite Company	—	New plant	Final plans approved
Standard Steel Springs Company	—	New plant	Plans under preparation
Two unnamed industries	—	2 New plants	(1)
17 unnamed industries	—	17 Undetermined	(1)
Pittsburgh (Part)	193,500	(2)	193,500 to Ohio River 262,250 to Monongahela River 275,600 to Allegheny River
Ben Avon	3,300	(2)	—
Ben Avon Heights	395	(2)	—
Emsworth	2,400	(2)	—
Neville Island Township	1,500	(2)	—
Glenfield	200	(2)	—
Coraopolis	11,000	New plant	Final plans approved
Osborne	530	(2)	—
Sewickley	5,600	(2)	—
Edgeworth	1,700	(2)	—
Leetsdale	2,300	(2)	—
Ambridge	25,000	New plant	Plans under preparation
Aliquippa	27,000	New plant	Final plans approved
Baden	2,100	New plant	Final plans approved
Conway	1,600	New plant	Plans under preparation
Freedom	3,200	New plant	Plans under preparation

See footnotes at end of table.

Table I$_1$. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Pennsylvania--Continued			
Monaca	8,000	New plant	Final plans approved
East Rochester	700	New plant	Plans under preparation
Beaver	5,600	New plant	Final plans approved
Midland	6,370	New plant	Final plans approved
McKees Rocks	24,000	(2)	—
Stowe Township	8,000	(2)	—
Bellevue	10,500	(2)	—
Avalon	6,300	(2)	—
Rochester	10,000	Undetermined	Abatement ordered
Washington	28,000	Enlargement	Final plans approved
Houston	1,600	Undetermined	Abatement ordered
Canonsburg	13,000	Undetermined	Abatement ordered
Bridgeville	4,460	(2)	—
Heidelberg	2,240	(2)	—
Mt. Lebanon Township	19,000	(2)	—
Scott Township	4,000	(2)	—
Carnegie	13,000	(2)	—
Crafton	7,500	(2)	—
Rosslyn Farms	380	(2)	—
Ingram	3,900	(2)	—
Greentree	700	(2)	—
Thornburg	285	(2)	—
McDonald	3,500	Undetermined	Abatement ordered
Dixmont Hospital	1,500	Enlargement	Abatement ordered
Oakdale	1,600	(2)	—
Collier Township	900	(2)	—
Baldwin Township	5,400	(2)	—
Borough Township	800	Undetermined	Abatement ordered
Brentwood	7,500	(2)	—
Castle Shannon	3,780	(2)	—
Chartiers Township	100	Undetermined	Abatement ordered
Claysville	600	New plant	Final plans approved
Dormont	13,000	(2)	—
Harmony Township	1,000	New plant	Final plans approved
Mt. Oliver	7,000	(2)	—
Penn Training School	850	Enlargement	Plans under preparation
North Strabane Township	1,500	Undetermined	—
One unnamed municipality	—	New plant	(1)
Two unnamed municipalities	—	Replacement	(1)
12 unnamed municipalities	—	Undetermined	(1)
West Virginia:			
Chester[3]	3,400	New plant	—
Harker Pottery Co.	—	Undetermined	—
Taylor, Smith & Taylor	—	Undetermined	—
Newell	1,500	New plant	County Court considering planning work
Knowles China Co.	—	Undetermined	—
Homer Laughlin China Company	—	Undetermined	—
New Castle Refractories Company[3]	—	Undetermined	—
New Cumberland	1,260	New plant	—
Hancock Manufacturing Co.	—	Undetermined	—

See footnotes at end of table.

Table I_1. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
West Virginia—continued			
Weirton[3]	17,000	New plant	Includes Weirton Heights and Hollidays Cove with Weirton.
Weirton Steel Company	—	New plant	—
Follansbee[3]	4,800	New plant	Phenolic wastes.
Koppers Co. Tar Products Division	—	New plant	Pilot plant dephenolizer, in operation.
Follansbee Works, Wheeling Steel Corp	—	New plant	Phenol recovery plant
Follansbee Steel Corp	—	New plant	Pickling wastes
Wellsburg[3]	5,500	New plant	Preliminary report completed but not submitted
S. George & Company	—	Undetermined	—
Pillsbury Mills	—	Undetermined	—
Hammond Bag & Paper Co	—	Undetermined	—
Beech Bottom	1,300	New plant	—
Beech Bottom Works, Wheeling Steel Corp	1,257	New plant	—
Power	400	New plant	—
Beech Bottom Power Co	—	Undetermined	—
Windsor Heights	—	Undetermined	(4)
Windsor Power House Coal Company	—	Undetermined	Coal washing wastes
Costanzo Coal Mining Co	—	Undetermined	Coal washing wastes
Wheeling[3]	59,000	New plant	Final plans approved 1949
W. Va. Match Corp	—	Undetermined	—
Stifel & Sons, Inc	16,000	New plant	—
La Belle Iron Works, Wheeling Steel Corp	—	Undetermined	—
Zinc Recovery Plant, Wheeling Steel Corp	—	Undetermined	—
Wheeling Stamping Co	—	Undetermined	—
Weimer Packing Co.	9,340	New plant	—
John Wenzel Co.		New plant	—
Ackerman Manufacturing Co	—	Undetermined	—
Augustus Pollack, Inc	—	Undetermined	—
Block Bros. Tobacco Co	—	Undetermined	—
Benwood[3]	4,000	New plant	Planning loan applied for
Vulcan Rail & Construction Company	—	Undetermined	—
Benwood Works, Wheeling Steel Corporation	—	New plant	—
United Packing Company	—	Undetermined	—
McMechan[3]	3,700	New plant	—
Glendale[3]	1,200	New plant	—
Louis Marx & Company	—	Undetermined	—
Moundsville[3]	14,000	New plant	Final plans approved 1948
Fostoria Glass Company	—	Undetermined	—
Triangle Conduit & Cable Company	—	Undetermined	—
U. S. Stamping Company	—	Undetermined	—
Captina	—	Undetermined	(4)
Proctor	—	Undetermined	(4)
New Martinsville[3]	3,400	New plant	Preliminary report completed but not submitted

See footnotes at end of table.

Table I_1. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--continued			
Glyco Products Co., Inc.....	—	Undetermined	—
Columbia Chemical Div.......	—	Undetermined	—
Pittsburgh Plate Glass Co...	—	—	—
Paden City[3].................	1,900	New plant	Plans in preparation
Paden City Glass Co.........	—	Undetermined	—
Paden City Pottery Co.......	—	Undetermined	—
Sistersville[3]...............	2,700	New plant	—
Friendly[3]...................	60	New plant	—
St. Marys[3]..................	2,200	New plant	—
Quaker State Oil Refining Company...................	—	Undetermined	—
Belmont......................	—	Undetermined	(4)
Willow Island...............	—	Undetermined	—
Calco Chemical Div., American Cyanamid Co......	—	Undetermined	All wastes are lagooned
Monongahela Power Co........	—	Undetermined	—
Waverly......................	—	Undetermined	(4)
Willamstown[3]................	1,400	New plant	—
Fenton Art Glass Co.........	—	Undetermined	—
American Bisque Co..........	—	Undetermined	—
Vienna[3].....................	2,340	New plant	—
Parkersburg[3] [5].............	38,000	New plant	Final plans approved
Parkersburg Silk Mills, Inc.	—	Undetermined	—
Ames Baldwin Wyoming Company...................	—	Undetermined	—
Mountain State Steel Foundries, Inc............	—	Undetermined	—
Parkersburg Steel Co........	—	Undetermined	—
Grossman Shoe Co............	—	Undetermined	—
H. Morland, Inc.............	—	Undetermined	—
Porcelain Products Inc......	—	Undetermined	—
E. I. DuPont de Nemours.....	11,400	Additions	Treatment required for sanitary wastes only
Ravenswood[3].................	1,060	New plant	—
New Haven[3]..................	500	New plant	—
Hartford[3]...................	—	Undetermined	(4)
Mason[3]......................	500	New plant	—
Clifton......................	—	Undetermined	(4)
West Columbia...............	—	Undetermined	(4)
W. Va. Coal and Trans. Company....................	—	Undetermined	Coal washing wastes
Hallwood.....................	—	Undetermined	(4)
Lakin........................	—	Undetermined	(4)
State Industrial School and Hospital.............	530	New plant	—
Point Pleasant[3] [5]...........	2,500	New plant	—
Yunker Manufacturing Co.....	—	Undetermined	—
Glenwood.....................	—	Undetermined	(4)
Huntington[3] [5]...............	75,000	New plant	[6]Abatement ordered; plans under preparation
Ceredo[3].....................	1,200	New plant	—
Kenova[3].....................	3,900	New plant	—
Jeffrey Dewitt Insulator Corp......................	—	Undetermined	—
Colliers.....................	—	Undetermined	(4)
Penowa Coal Company.........	—	Undetermined	Coal washing wastes

See footnotes at end of table.

Table I₁. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
West Virginia—continued			
Collier Steel Corp.	—	Undetermined	—
Weirton Provision Co.	—	Undetermined	—
Bethany[3]	950	New plant	Ordered to abate pollution by State Health Department
Bethany College	763	Undetermined	—
McKinleyville	—	Undetermined	(4)
West Liberty	—	Undetermined	(4)
Valley Camp Coal Mining Company	—	New plant	—
Wheeling Machine Products Company	—	Undetermined	Neutralizes pickle wastes
Wheeling Corrugating Company	—	Undetermined	—
George L. Sigler	—	New plant	—
Valley Grove	—	Undetermined	(4)
Triadelphia[3]	200	New plant	—
Roney Point	—	Undetermined	—
W. Va. State Penitentiary	1,850	Additions	Under construction
Cameron[3]	300	New plant	—
Cameron Clay Products Inc.	—	Undetermined	—
Glen Easton	—	Undetermined	(4)
Hundred[3]	650	New plant	—
Littleton[3]	320	New plant	—
Pine Grove[3]	100	New plant	—
Reader	—	Undetermined	(4)
Brooklyn	—	Undetermined	(4)
Folsom	—	Undetermined	(4)
Smithfield[3]	—	Undetermined	(4)
Jacksonburg	—	Undetermined	(4)
Hastings	280	New plant	—
Carbide & Carbon Chemicals Corporation	—	Undetermined	—
West Union[3]	1,000	New plant	—
Myles Manufacturing Co.	—	Undetermined	—
Middlebourne[3]	600	New plant	—
Ripley[3]	1,200	New plant	—
Cottageville	—	Undetermined	(4)
Wayne	400	New plant	—
East Lynn	—	Undetermined	(4)
Dingess	—	Undetermined	(4)
Ohio:			
East Liverpool	23,555	New plant	Detailed plans approved June 1950
Wellsville	7,672	New plant	Detailed plans approved December 1948
Toronto	7,426	New plant	General plans approved May 1947
Toronto Paper Manufacturing Co.	6,700	Undetermined	—
Follansbe Steel Corp.	—	New plant	—
Steubenville	37,651	New plant	Detailed plans approved January 1950
Weirton Steel Co.	—	New plant	—
Wheeling Steel	—	New plant	6,260 lbs. sulphuric acid, waste daily

See footnotes at end of table.

Table I₁. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Ohio—continued			
Liberty Paper Board Co.	12,000	New plant	—
Mingo Junction	5,192	New plant	—
Carnegie-Illinois Steel Company	—	New plant	—
Brilliant	1,683	New plant	—
Tiltonville	2,360	New plant	—
Yorkville	1,961	New plant	—
Wheeling Steel Corp.	—	New plant	Pickling wastes
Martins Ferry	14,729	New plant	—
Wheeling Steel Corp.	—	New plant	Blast furnace
Wheeling Steel Corp.	—	New plant	Galvanizing
Bridgeport	4,853	New plant	—
Bellaire	13,799	New plant	—
Bellaire Enamel Co.	—	New plant	—
Shadyside	4,048	New plant	—
Powhatan Point	2,054	New plant	New plant under construction
New Matamoras	793	New plant	—
Marietta	14,543	New plant	Plans under preparation
Belpre	1,717	New plant	—
Pomeroy Salt Corp.	—	Undetermined	—
Pomeroy	3,581	New plant	Detailed plans approved February 1947
Excelsior Salt Works	—	New plant	—
Middleport	3,356	New plant	Detailed plans approved January 1948
Gallipolis	7,832	New plant	General plans approved June 1946
Proctorville	731	New plant	—
Chesapeake	1,068	Additions	—
Coal Grove	2,351	New plant	—
Ironton	15,851	New plant	Detailed plans approved November 1947
Semet Solvay Division Allied Chemical & Dye Corporation	6,700	Additions	Dephenolizer effluent, ammonia still waste
Barret Division of Allied Chemical & Dye Corp.	1,900	Additions	Tar processing waste; phthalic anhydride processing waste
Foster Stove Company	—	New plant	—
Wheelersburg	300	New plant	(4)
New Boston	6,024	New plant	Detailed plans approved April 1949
Detroit Steel Corp. By-Products Coke Plant	—	New plant	4.61 M.G.D. wastes
Detroit Steel Corp. blast furnace, steel mills	7,600	New plant	—
Portsmouth	40,466	New plant	Detailed plans approved May 1948
Schisler Prov. Co.	2,300	New plant	—
Manchester	2,163	New plant	Detailed plans approved February 1949
Ripley	1,623	New plant	—
New Richmond	1,767	New plant	—

See footnotes at end of table.

Table I_1. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Ohio--continued			
J. & H. Clasgens Co.	1,300	New plant	—
Cincinnati	512,000	New plant	—
The following 12 population centers are included with Cincinnati:			
Arlington Heights	Included	with Cincinnati	It is anticipated that 4 or more treatment plants will be required to serve Cincinnati and 12 other population centers tributary to the Cincinnati Sewerage System. Each of these 12 population centers is considered as a separate municipal waste source in preceding tables.
Cheviot	do	do	
Elmwood Place	do	do	
Greenhills	do	do	
Lockland	do	do	
Mt. Healthy	do	do	
North College Hill	do	do	
Norwood	do	do	
Reading	do	do	
St. Bernard	do	do	
Sharonville	do	do	—
Wyoming	do	do	—
Wood Preserving Corp.	—	New plant	—
Mullins Manufacturing Co. No. 3	—	New plant	—
Mullins Manufacturing Co. No. 1	—	New plant	—
Lisbon	3,400	New plant	Detailed plans approved April, 1949
New Waterford	547	New plant	—
Amsterdam	1,177	New plant	(4)
Bergholtz	1,122	New plant	(4)
Salineville	2,018	New plant	(4)
Flushing	1,217	New plant	(4)
Brookside	975	New plant	(4)
Morristown	410	New plant	—
St. Clairsville	2,797	Additions	2 plants now serve sewered portions of city
Caldwell	1,705	New plant	—
Harmon Chemicals, Inc.	—	New plant	—
Calco Div. of American Cyanamid Co.	—	Undetermined	—
McArthur	1,288	Additions	—
Wellston	5,537	Additions	—
C. C. Scott Packing Co.	300	New plant	—
Cranston Chemical Co.	—	New plant	—
West Union	1,334	New plant	Detailed plans approved September, 1948
Glendale	2,359	Additions	--
Kentucky:			
Catlettsburg	4,125	New plant	Abatement ordered
Semet-Solvay Co.	15,000	Additions	—
Ashland	20,200	New plant	See note (3) under table C^1. Abatement ordered
Armco Steel Corp.	—	New plant	—
Russell	1,890	New plant	—
Kopperswood Preserving Company	—	New plant	—
Worthington	400	New plant	—

See footnotes at end of table.

Table I_1. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Kentucky--continued			
Raceland	1,050	New plant	--
Grayson	770	Undetermined	--
Olive Hill	800	Undetermined	--
Fullerton	200	New plant	--
Vanceburg	1,280	New plant	--
Maysville	6,300	New plant	Plans under preparation
Weis Packing Company	400	New plant	--
George T. Stagg Co.	5,300	New plant	--
Augusta	200	New plant	--
Silver Grove	670	New plant	--
Fort Thomas	12,610	New plant[7]	See note (3) under table C_1. Plans under preparation
Dayton	8,835	New plant[7]	Plans under preparation
Bellevue	9,025	New plant[7]	Plans under preparation
Covington	67,900	New plant[7]	Plans under preparation
Fort Mitchell	400	New plant	--
Fort Wright	--	New plant	--
Newport	34,300	New plant[7]	Plans under preparation
Andrews Steel Co.	--	New plant	--
Southgate	1,900	New plant[7]	Plans under preparation
Erlanger	630	New plant	--
Park Hills	1,600	New plant[7]	See note (3) under table C_1. Plans under preparation
South Fort Mitchell	2,393	New plant	Final plans approved
Ludlow	5,940	New plant[7]	Plans under preparation
Bromley	1,075	New plant	Plans under preparation
Warsaw	200	New plant	--
Carrollton	650	New plant	Plans under preparation
Stohl Oil Refining Co.	1,000	Undetermined	--
Louisville	325,000	New plant	Plans under preparation
Louisville Refining Co.	3,300	Undetermined	--
E. I. DuPont de Nemours & Co.	--	do	Synthetic rubber plant
B. F. Goodrich Chemical Co.	--	do	Synthetic rubber plant
Ky. Synthetic Rubber Co.	--	do	Synthetic rubber plant
Stoker Tenderex Farms	1,500	do	--
Reynolds Metal Co.	--	do	Aluminum fabrication
Palmer Asbestos Rubber Co.	--	do	Roofing materials
National Carbide Co.	--	do	--
International Harvester Co.	--	do	Farm machinery
Ford Motor Company	--	do	Auto assembly
Aetna Oil Service, Inc.	4,500	do	--
West Point	992	New plant	Abatement ordered
Pebbleford Distillery	--	New plant	--
Hardinsburg	560	Additions	Plans under preparation
Cloverport	--	Undetermined	(4)
Hawesville	400	New plant	--
Lewisport	200	New plant	--
Fleischmann Dist. Co.	6,600	New plant	--
Owensboro Dist. Co.	1,800	New plant	--
Owensboro	26,000	New plant	Final plans approved
Glenmore Dist. Co.	8,400	New plant	--
Henderson	11,000	New plant	Abatement ordered
Farmers Tankage Co.	--	New plant	--
Eckert Packing Co.	--	New plant	--
Uniontown	250	New plant	--
Paducah	28,900	New plant	Final plans approved

See footnotes at end of table.

Table I$_1$. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Kentucky--continued			
Dawson Springs..............	1,250	New plant	—
Dawson Daylight Coal Co.....	150	New plant	—
Veterans Hospital...........	—	New plant	—
Earlington..................	600	New plant	Final plans approved
Homestead Coal Company......	—	Undetermined	Coal washing
Williams Coal Company.......	—	Undetermined	Coal washing
Acme Packing Company........	—	New plant	—
Sturgis.....................	1,150	Additions	—
Indiana:			
Aurora......................	4,828	New plant	—
Rising Sun..................	1,545	New plant	Loan application submitted
Madison.....................	6,923	New plant	Under construction
Madison State Hospital......	2,000	New plant	Final plans approved
Jeffersonville..............	11,493	New plant	Final plans in preparation
Clarksville.................	2,386	New plant	Preliminary plans approved
Colgate-Palmolive-Peet Co...	13,400	Undetermined	Company surveying wastes
New Albany..................	25,414	New plant	Final plans approved
Moser Leather Company.......	—	Enlargement	—
Cannelton...................	2,240	New plant	Final plans approved
Tell City...................	5,395	New plant	Final plans approved
Rockport....................	2,421	New plant	—
Newburgh....................	1,374	New plant	—
Evansville..................	97,062	New plant	Preliminary plans approved
Indiana Farm Bur. Oil Refinery..................	—	New plant	—
Mt. Vernon..................	5,638	New plant	—
James Walsh Distillery......	900	New plant	—
J. F. Seagram Distillery....	26,000	New plant	—
Schenley Distilleries.......	76,000	New plant	—
Everitt Packing Co..........	—	New plant	—
Monon Veneer Co.............	—	New plant	—
Corydon.....................	1,865	Enlargement	—
A. E. Wenning Meats.........	—	Undetermined	—
Salem.......................	3,194	Enlargement	—
Boonville...................	4,526	New plant	Final plans in preparation
Stahl Packing Co............	—	New plant	City sewer connection possible
S. G. Newman Meat Co........	—	New plant	City sewer connection possible
Evansville Packing Co.......	—	New plant	City sewer connection possible
Mahon-Hitch Packing Co......	—	Additions	City sewer connection possible
City Rendering Plant........	—	New plant	City sewer connection possible
Fort Branch.................	1,552	New plant	Planning loan applied for
Emge Packing Co.............	4,205	Enlargement	—
Dewig Packing Co............	—	Enlargement	—
Illinois:			
Rosiclare...................	400	Undetermined	Plans being prepared
Golconda....................	50	Undetermined	—
Metropolis..................	5,000	Undetermined	—
Mound City..................	1,500	Undetermined	—
Cairo.......................	10,000	Undetermined	—
Peabody Coal Company........	—	Additions	Improvements under way

See footnotes at end of table.

Table 11. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Illinois--continued			
Sahara Coal Company..........	—	Additions	Improvements under way
Eldorado......................	2,000	New plant	—
Norris City...................	1,295	New plant	Under construction
Mounds........................	1,000	New plant	—

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B.O.D.

[1] Sources of pollution in Pennsylvania which need corrective action are not listed by name unless formal action has been taken by the State Sanitary Water Board. Abatement orders have been issued to all locations in Pennsylvania except those unnamed sources marked thus, (1).

[2] These locations have entered into an agreement with the Allegheny County Sanitary Authority to treat sewage at a central point.

[3] Incorporated communities in West Virginia.

[4] No comprehensive public sewerage system.

[5] Parkersburg, W. Va., discharges to both the Ohio and Little Kanawha Rivers. Point Pleasant, W. Va., discharges to both the Ohio and Kanawha Rivers. Huntington, W. Va., discharges to both the Ohio and Guyandot Rivers. Tabular data for these cities are included with the Ohio Main Stem Sub-Basin and are excluded from the tributary sub-basins.

[6] Several industries, now discharging to Huntington city sewers, will be required to pretreat wastes when that city provides sewage treatment.

[7] These municipalities are included in the Kenton-Campbell County Sanitation District and will be connected to the District System.

ALLEGHENY RIVER SUB-BASIN

General Description

The Allegheny River originates near Coudersport in northwestern Pennsylvania, flows in a northwesterly direction into the State of New York, then turns south and flows in a southwesterly direction across western Pennsylvania and finally joins the Monongahela River at Pittsburgh to form the Ohio River. The principal tributaries are Conewango Creek, Tionesta Creek, French Creek, Clarion River, Redbank Creek, Mahoning Creek, Crooked Creek, and the Kiskiminetas River. The area of the sub-basin is about 11,730 square miles of which 9,775 square miles are in Pennsylvania and 1,955 in New York. The topography of the area varies from the Appalachian Mountain Ridge area in the eastern and southern part to rolling plains in the western part. The northwestern part of the sub-basin, comprising about 25 percent of the total area, is in a glaciated region and is characterized by many lakes and swamps.

Economic Development

Coal is the most important natural resource in the sub-basin. Other natural resources include oil, gas, timber, stone, shales, clays, and sand and gravel. All types of industry exist in the sub-basin, the most important of which include those related to iron and steel, food, petroleum, coal, lumber and wood, leather, chemical, paper textiles, glass, cement, ceramic, and electrical equipment industries. Agriculture is one of the principal pursuits in the sub-basin.

Rainfall and Runoff

The average annual rainfall is about 42 inches with a variation in the average from about 36 inches in the western part to about 47 inches in the southeastern part. Yearly and monthly variations from the averages are large, the minimum and maximum monthly precipitations having been 0.11 and 13.9 inches respectively and the minimum and maximum annual precipitations having been 22.7 and 59.7 inches. The average runoff is about 22 inches. The average monthly runoff has varied between 8 inches plus to about 0.1 inch. Flow data from 28 gaging stations in the sub-basin are currently being reported in the Geological Survey Water Supply Papers. Many other gaging stations are maintained by other agencies. Stream flows vary between extremely high flows during damaging floods to low flows which are inadequate to meet stream use demands.

Major River Developments

Eight locks and dams on the main stem provide a 9-foot navigation channel up to about mile 72 near East Brady, Pa. Four flood control reservoirs have been constructed by the Army Corps of Engineers on the tributaries of the Allegheny. One privately owned power reservoir is located on the Clarion River. The comprehensive plan of the Corps of Engineers includes one flood control and low water regulation reservoir under construction, two flood control and water regulation reservoirs authorized, one flood control reservoir under construction and one authorized for construction, and several potential reservoirs which may be for single or multiple purposes.

Population

The 1940 population in the sub-basin was about 1,480,000. Of this total, the 1940 population in municipalities and other population centers now listed by the State water pollution control agencies as contributing pollution was about 933,000.

Water Uses

Water uses in the sub-basin include municipal, industrial, and livestock water supplies, navigation (see "Major River Developments"), power, fish and wildlife propagation, wastes disposal and recreation.

There are 73 municipal surface water supplies serving water to 93 municipalities and serving an estimated population of about 1,102,300. Some of the population served by surface water in this sub-basin is located in other sub-basins. Industrial water supply demands exceed domestic requirements. There has been relatively little power development to date but the potential development is considerable. Use of the streams for fishing and recreation is extensive, although pollution of the streams limits full use of the streams for those purposes. There is much demand for improvements for recreational purposes as is evidenced by the interest in conservation pools of flood control reservoirs. The streams are used for waste disposal to the extent that there is conflict with other water uses.

Sources of Pollution

There are 203 municipalities and other population centers which have been listed by State water pollution control agencies as contributing to the pollution of the streams. Of these, 144 have an estimated population served of about 806,000. The equivalent population waste load discharged to the streams from these 144 sources is estimated at about 918,500. There are 51 sources of pollution having an estimated population served of 166,800, and 8 sources for which no population served estimate is available, which discharge an undetermined waste load to the streams. Of these sources, 17 do not have a comprehensive public sewerage system.

Industrial waste is discharged directly to the streams from 141 sources. Of these, 68 discharge an organic waste load equivalent to a population of 380,600, 32 discharge an undetermined organic waste load, and 5 discharge an undetermined type of waste load, There are 53 industries discharging inorganic, wastes, 17 of which also discharge organic wastes.

Acid mine drainage is an important source of stream pollution. About 80 percent of the acid mine drainage is released in the Kiskiminetas River drainage area. The estimated acid load after mine sealing was 375,500 tons per year in 1940.

Effects of Pollution on Water Uses

The wastes discharged to the streams result in high coliform bacteria counts, deficient oxygen content, and acid stream conditions. Areas of coliform bacteria content too high to permit use of waters for municipal water supply or bathing purposes are scattered through the sub-basin. Conditions of oxygen deficiency exist in many locations, although the oxygen content of a large percentage of the streams is sufficient to support aquatic life.

Acid conditions detrimental to all water uses exist in portions of the sub-basin, principally in the Kiskiminetas River drainage area, the headwaters of Red Bank Creek, Mahoning Creek, and the Clarion River, in other smaller tributaries in the southern part of the area, and in the main stem below the Kiskiminetas River.

Treatment Provided

Primary treatment is provided at 33 municipal sources of pollution which have a population served of about 138,400. Secondary treatment is provided at 22 sources having a population served of about 51,000. No treatment is provided at 148 locations having an estimated population served of more than 783,000. Thus, less than 20 percent of the population contributing waste to the streams is served by any form of sewage treatment. Moreover, of the 56 treatment plants serving 55 municipalities only 30 are known to be satisfactory from a capacity standpoint.

Sixty-three industrial sources of pollution have some form of waste treatment, 74 have no treatment, and the treatment status at 4 locations is undetermined. As shown by Table E_2, about 30 percent of the industrial waste treatment plants are satisfactory.

Treatment Plants Required

New waste treatment plants are required at 85 municipal sources of pollution. The population served by sewers at 84 of these municipalities is estimated at 693,500. The population of the other municipality has not been determined. Twelve municipalities, with a population served of 58,900, require enlargements or additions to existing plants. Table G_2 lists the requirements at 89 municipalities as being undetermined. A large percentage of these are located in Pennsylvania and have been included in the undetermined classification because formal action to establish treatment requirements has not been taken by the Sanitary Water Board. Eighty-two of these locations have an estimated combined population served by sewers of 146,300, while the population served at 7 locations has not been determined. Industrial waste treatment requirements include 67 new plants and 22 enlargements or additions. The requirements at 27 sources of industrial pollution have not been determined. Table I_2 lists individual municipal and industrial projects known to be needed. Many of the industries are located in or adjacent to municipalities. It is expected that a large number of those which are tabulated as requiring new treatment facilities will meet pollution abatement requirements by connecting to municipal systems.

Tabular Data

Tables A_2 through I_2 list additional data relative to pollution abatement in the sub-basin. Table G_2 contains summary data relative to treatment plant requirements in the sub-basin. Table I_2 lists individual municipal and industrial projects required.

Table A_2. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	144	805,825	918,450
Having population data available (Data on pollution load to watercourse incomplete or not available)	59[1] [2]	166,826[1]	Not applicable
Total	203	972,651	--

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 17 communities having no comprehensive public sewerage system. Of these, 16 have an estimated combined population of 11,911 and no population data have been obtained for the other.

[2] Includes 7 other communities for which population data have not been obtained.

Table B_2. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	68**	380,628
Producing organic wastes	32	Undetermined
Producing inorganic wastes	53	Not applicable
Producing wastes of undetermined type	5	Undetermined
Total	141[1]	--

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 17 plants also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus, **.

Table C_2. Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	33	31	138,360
Secondary	22	25	51,060
No treatment	148**	--	783,231

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes 16 communities having no comprehensive public sewerage system, but for which population data are available. These communities have an estimated combined population of 11,911. Also includes 8 other locations for which population data have not been obtained, one of which has no comprehensive public sewerage system.

Table D_2. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products	47	21	24	2
Textile mill products	3	0	3	0
Lumber and wood products	5	2	3	0
Paper and allied products	3	2	1	0
Chemical and allied products	6	2	3	1
Products of petroleum and coal	20	18	2	0
Rubber products	1	0	1	0
Leather and leather products	9	7	2	0
Primary metal industries	9	3	6	0
Fabricated metal industries	28	3	25	0
Miscellaneous	9	5	3	1
Undetermined	1	0	1	0
Totals	141	63	74	4

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_2. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	56*	30**	10	16	29	10	17
Industrial	63	19	18	26	22	12	29

*56 treatment plants serving 55 communities.

**30 plants, some of which are listed as satisfactory in this table, are included in Tables G_2 and I_2 as undetermined with respect to project requirements. The reason for this is that the existing plants are satisfactory on the basis of the original design, but additional facilities may be required following establishment of water quality objectives by State agencies having jurisdiction.

Table F_2. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	1	Undetermined	1	Undetermined
1947	0	--	1	do
1948	2	Undetermined	8	do
1949	1	do	8	do

Table G_2. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number ** [1]	Population served by facilities	Number ** [1]
New plant	85[2]	693,547[2]	67
Enlargement or additions to existing plant	12	58,900	22
Replace existing plant	0	--	0
No project required	17	73,850	25[3]
Undetermined	89[4]	146,354[4]	27

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Therefore, the listing of requirements in this table is not necessarily in agreement with requirements which may be indicated by preceding tables. See discussion under "Pollution Prevention Measures Required," Part 1 of the report.

[2] Includes 20 communities which have agreed to connect up with the Allegheny County Sanitary Authority to treat sewage at a central plant and 2 communities which have agreed to connect to the sewage treatment plants for the city of Johnstown, Pa. Also includes 15 communities having no comprehensive sewage system, 14 of which have a combined population of 10,847.

[3] Includes some industries listed in table E_2 as "undetermined." Apparently no projects will be required at some locations although final determination of requirements has not been made.

[4] Includes two communities having no comprehensive public sewerage systems but with an estimated combined population of 1,064. Also includes 7 communities for which population data have not been obtained. (See note** under table E_2.)

Table H_2. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	61	18
Abatement ordered	1	0
Plans under preparation	24	19
Final plans approved	51	13
Construction awaiting financing	0	4
Under construction	1	0
Status undetermined	48	62

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage. For example, the State of Pennsylvania has issued orders to 76 municipalities and 38 industries in the sub-basin and all but one of these have made progress to abate pollution.

Table I_2. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
New York:			
Sacony-Vacuum Oil Co.	—	Additions	Sanitary sewage now to city sewer
St. Bonaventure College	1,500	New plant	—
Allegany	1,400	Enlargement and additions	Extend collection system
Wiedman Ice Cream Co.	—	(1)	—
Salamanca	9,500	New plant	Final plans approved
Gordon Baking Company	—	New plant	Sanitary sewage now to municipal system
Union Tanning Co.	—	New plant	Sanitary sewage now to municipal system
Fairmont Creamery	—	New plant	—
Abbott Dairy	—	New plant	—
Utility Ice Cream Co.	—	New plant	Under construction
Richburg	564	Undetermined	[2]Eventually will need sewerage system
Portville	1,018	New plant	[2]Plans under preparation
Hinsdale W.D.	—	New plant	(2)
Crosby Dairy	—	Additions	—
Machias	625	New plant	(2)
Ontario Knife Co.	—	Enlargement	Sanitary sewage now to municipal system
Cuba Cheese Factory	—	New plant	Affects a public water supply
Hardy's Corner Cheese Factory	—	New plant	Affects a public water supply
Limestone	558	New plant	[2]100 outlets to creek
Jordan Dairy	—	New plant	—
Ellicottville	1,024	New plant	[2]475 outlets to creek
Borden's (Ellicottville)	—	New plant	—
Murphy & Sons	—	New plant	Manufacturing wood products Sanitary sewage to stream
Burrell Cutlery Co.	—	New plant	Sanitary sewage and industrial waste
Arnot Metal Company	—	New plant	Sanitary sewage and industrial waste
Ellicottville Basket Company	—	New plant	Sanitary sewage and industrial waste
Fitzpatrick and Weller	—	New plant	Sanitary sewage and industrial waste. Wood products
Killbuck W. D.	300	New plant	[2]25 outlets to creek
Little Valley	1,234	New plant	[2]25 outlets to creek
Kinfolks, Inc	—	New plant	Sanitary sewage to cesspool satisfactory
Cattaraugus Cutlery Company.	—	New plant	Sanitary sewage to cesspool satisfactory
Borden's, Inc. (Little Valley)	—	Additions	—
Queensboro Milk Co.	—	Additions	Sanitary sewage treatment satisfactory
Borden's, Inc. (Frewsburg)	—	New plant	—
Moll Hide Company	—	New plant	—
Randolph	1,321	New plant	[2]250 outlets to creek
Borden Co. (Randolph)	—	New plant	Sanitary sewage with industrial waste

See footnotes at end of table.

Table I₂. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
New York--Continued			
South Dayton	643	New plant	[2]100 outlets to stream
Fuller Canneries Co.	—	Additions	Plant inoperative at present
Mohawk Milk Prod. Co.	—	New plant	For industrial wastes
East Randolph	496	New plant	[2]50 outlets to creek
Cassadaga	514	New plant	(2)
Jamestown	43,000	Enlargement	Plans under preparation
Lily Dale Assembly	2,000	Enlargement	Summer population
Sinclairville	585	New plant	[2]120 outlets to Mill Creek
Art Metal Construction Co. (Jamestown, Jones St.)	—	Additions	Metal plating wastes
Crescent Tool Co.	—	New plant	Sanitary sewage now to city sewers
Art Metal Construction Co. (River St., Jamestown)	—	New plant	Sanitary sewage combined with industrial waste
Watson Manufacturing Co.	—	Additions	Sanitary sewage now to city sewers
Art Metal Construction Co. (Taylor St., Jamestown	—	New plant	Sanitary sewage now to city sewers
Monarch Fuse Company	—	(1)	Sanitary sewage now to city sewers
Jamestown Electroplating Works	—	New plant	Sanitary sewage now to city sewers
Empire Worsted Mills	—	New plant	Sanitary sewage now to city sewers
Marlin-Rockwell Co. Manufacturing ball bearings	—	New plant	Sanitary sewage now to city sewers
Plomb Tool Co., Inc.	—	New plant	Sanitary sewage now to city sewers. Plating wastes
Nonquist Products Co. (Jamestown)	—	New plant	Sanitary sewage and industrial waste
Chautauqua Hardware Co. (Jamestown)	—	New plant	Plating wastes
Blackstone Corp. (Jamestown)	—	New plant	Metal wastes
Jamestown Malleable Iron Company	—	New plant	Metal wastes
Weber-Knapp Company	—	New plant	Sanitary sewage now to city sewers. Metal plating wastes
Falconer Plate Glass Co.	—	Additions	For industrial waste
Swanson Mach. Co.	—	(1)	Sanitary sewage combined with industrial waste
National Worsted Mills	—	New plant	For industrial waste
Steel Partitions Co. (Falconer) Plant No. 2	—	(1)	Sanitary sewage combined with industrial waste
Mayville	1,354	New plant	[2]Final plans approved
Pt. Chautauqua Land Association	500	Undetermined	[2]35 outlets to lake

See footnotes at end of table.

Table I_2. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served **	Project requirements	Remarks
New York--Continued			
F. W. Wappet Co.	—	New plant	For sanitary sewage
Kling Furniture Co.	—	Additions	For sanitary sewage
Chautauqua Malted Milk Co., Inc	—	Additions	—
Niobe Cheese Company	—	New plant	—
Clymer	500	New plant	(2)
Dairyman's League Co-op. Association, Inc. (Clymer)	—	New plant	For sanitary sewage and milk plant wastes
Sherman	675	New plant	[2]150 outlets to French Creek
Dairyman's League Co-op. Association (Sherman)	—	New plant	For sanitary sewage and milk plant wastes
Pennsylvania:			
Arnold	10,900	(3)	—
Aspinwall	5,200	(3)	—
Bentleyville	1,000	New plant	Plans under preparation
Brackenridge	6,900	(3)	—
Bradford	18,000	New plant	Plans under preparation
Brookville	4,300	New plant	Final plans approved
Carmichaels	100	Undetermined	Abatement ordered
Cheswick	1,200	(3)	—
Cokeburg	150	New plant	Plans under preparation
Corry	7,000	New plant	Final plans approved
Coudersport	2,200	New plant	Plans under preparation
Derry	3,000	Enlargement	Final plans approved
Du Bois	12,000	New plant	Final plans approved
East Brady	1,400	New plant	Final plans approved
East Deer Township	2,000	(3)	—
Eldred	1,000	New plant	Final plans approved
Ellsworth	350	Enlargement	Plans under preparation
Etna	11,700	(3)	—
Fair Chance	500	New plant	Plans under preparation
Finleyville	250	New plant	Plans under preparation
Ford City	5,900	Enlargement	Final plans approved
Foxburg	400	New plant	Final plans approved
Fox Chapel	200	(3)	—
Freeport	2,700	New plant	Final plans approved
Harrison Township	6,500	(3)	—
Indianola	1,000	Enlargement	Plans under preparation
Kane (Part)	3,200	New plant	Final plans approved
Kittanning	7,500	New plant	Final plans approved
Millvale	19,800	(3)	—
Mt. Jewett	1,400	New plant	Plans under preparation
New Bethlehem	2,100	New plant	Plans under preparation
New Kensington	20,700	(3)	—
Oakmont	6,200	(3)	—
Oil City	20,000	New plant	Final plans approved
Pittsburgh (part)	275,600	(3)	275,600 to Allegheny River 262,250 to Monongahela River 193,500 to Ohio River
Port Allegheny	2,300	New plant	Plans under preparation
Punxsutawney	8,600	New plant	Final plans approved

See footnotes at end of table.

Table I_2. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served **	Project requirements	Remarks
Pennsylvania--Continued			
Rouseville	1,000	New plant	Final plans approved
Shaler Township	8,000	(3)	—
Sharpsburg	8,200	(3)	—
Sheffield Township	250	Enlargement	Final plans approved
Shingle House	1,100	New plant	Plans under preparation
Sligo	500	New plant	Final plans approved
Smethport	1,600	New plant	Plans under preparation
South Bethlehem	550	New plant	Plans under preparation
Springdale	5,000	(3)	—
Springdale Township	800	(3)	—
Sugarcreek Township	—	New plant	Plans under preparation
Tarentum	9,800	(3)	—
Tidioute	500	New plant	Plans under preparation
Tionesta	600	New plant	Final plans approved
Titusville	8,100	New plant	Final plans approved
Verona	3,500	(3)	—
Warren	15,000	New plant	Final plans approved
Westview	1,300	(3)	—
Fox Chapel Country Club	100	Enlargement	Final plans approved
Applewold	400	New plant	Plans under preparation
Kane (Part)	3,100	New plant	Final plans approved
Abbots Dairies, Inc	—	New plant	Plans under preparation
Sherwood Refining Co	—	New plant	Under construction
Pittsburgh Plate Glass Company	—	New plant	Final plans approved
Pennsylvania Salt Co	—	Enlargement	Plans under preparation
Tarentum Paper Mills	—	New plant	Plans under preparation
Aluminum Co. of America	—	New plant	Plans under preparation
Edgewater Steel Co	—	Enlargement	Plans under preparation
Wm. B. Scaife & Sons	—	New plant	Plans under preparation
U. S. Gypsum Co	—	Enlargement	Plans under preparation
Carnegie-Illinois Steel Company	—	New plant	Plans under preparation
Enameled Metals Co	—	New plant	Plans under preparation
National Supply Co	—	New plant	Plans under preparation
Hubbard Co	—	New plant	Final plans approved
Waverly Oil Works	—	New plant	Final plans approved
Fried & Reinemann Packing Company	—	Enlargement	Final plans approved
Kendall Refining Co	—	Enlargement	Plans under preparation
Dairyman's League Co-op. Association	—	New plant	Final plans approved
Pennsylvania Refining Co. Plant No. 1	—	New plant	Plans under preparation
Pennzoil Company	—	New plant	Final plans approved
Pennsylvania Refining Co. Plant No.2	—	New plant	Under construction
Daugherty Refining Co	—	New plant	Under construction
Ridgway	6,300	New plant	Final plans approved
St. Marys	7,800	New plant	Final plans approved
New York & Pennsylvania Company	—	Enlargement	Final plans approved
Keystone Tanning & Glue Co. Plant No. 1	—	Enlargement	Plans under preparation
Keystone Tanning & Glue Co. Plant No. 2	—	Enlargement	Plans under preparation

See footnotes at end of table.

Table I_2. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served **	Project requirements	Remarks
Pennsylvania--Continued			
Armour Leather Co.	--	Enlargement	Plans under preparation
Barr	400	Enlargement	Plans under preparation
Brownstown	1,300	New plant	Final plans approved
East Conemaugh	4,800	New plant	Plans under preparation
Ferndale	2,700	New plant	Plans under preparation
Franklin	2,300	New plant	Plans under preparation
Homer City	1,700	New plant	Final plans approved
Indiana	10,000	New plant	Final plans approved
Johnstown	75,000	New plant	Final plans approved
Latrobe	8,400	New plant	Final plans approved
Ligonier	2,100	New plant	Plans under preparation
Lorraine	1,200	(4)	Johnstown sewers
Southmont	2,400	(3)	--
Westmont	3,600	(4)	Johnstown sewers
Geistown	2,100	New plant	Final plans approved
Latrobe Brewing Co.	3,000	New plant	Final plans approved
Herce Manufacturing Co.	1,300	New plant	Final plans approved
I.X.L. Creamery	100	New plant	Plans under preparation
McCreary Tire & Rubber Co.	100	New plant	Final plans approved
2 Unnamed municipalities	12,250	New plant	(5)
2 Unnamed municipalities	1,500	Enlargement	(5)
86 Unnamed municipalities	145,190	Undetermined	(5)
6 Unnamed industries	--	New plant	(5)
2 Unnamed industries	--	Enlargement	(5)
27 Unnamed industries	--	Undetermined	(5)

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Organic industrial waste load is expressed in terms of population equivalent as measured by B.O.D.

[1] These locations in the State of New York have no waste treatment facilities at present. It has been recommended by the State Water Pollution Control Agency that the connections be made to municipal sewerage systems. Included under "New plant" in table G_2.

[2] Communities having no comprehensive public sewerage system.

[3] These municipalities have signed agreements with the Allegheny County Sanitary Authority to treat wastes at a central point. They are included under "New plant" in table G_2.

[4] These communities have signed agreements with the City of Johnstown to treat wastes at a central point. They are included under "New plant" in table G_2.

[5] These sources of stream pollution in Pennsylvania are unnamed because final action as to treatment requirements has not been taken by the State Sanitary Water Board. All locations listed by name in Pennsylvania have received orders to abate pollution.

MONONGAHELA RIVER SUB-BASIN

General Description

The headwaters of the Monongahela River originate in the mountains of West Virginia. The Tygart and West Fork Rivers, with headwaters about 70 miles south of the Pennsylvania-West Virginia boundary, flow generally northward until they reach Fairmont, where they join to form the Monongahela. From Fairmont the main stream continues northward about 128 river miles through northern West Virginia and southern Pennsylvania, finally joining the Allegheny River at Pittsburgh to form the Ohio River.

The Monongahela Sub-Basin includes a total area of 7,380 square miles, of which about 5 percent is in western Maryland, 57 percent in West Virginia, and 38 percent in southwestern Pennsylvania. The Youghiogheny is the largest tributary, with a drainage area of 1,768 square miles, and is followed by the Cheat, Tygart, and West Fork Rivers, with drainage areas of 1,424 square miles, 1,369 square miles, and 882 square miles, respectively. The ridges of the Appalachian Mountains encircle the southern and eastern edges of the sub-basin. The entire sub-basin is in the Appalachian Plateau area and is characterized by rugged terrain with deep narrow valleys.

Economic Development

Among the natural resources of the sub-basin are tillable land, water power, navigable waterways, and extensive coal deposits. The coal deposits, many of which are of the type necessary in the metallurgical industries, have fostered the great development of iron and steel mills in the area, centered at Pittsburgh, Pa., and at Morgantown and Fairmont, W. Va. Coal is also shipped outside the sub-basin to other iron and steel centers.

Rainfall and Runoff

Rainfall is abundant throughout the sub-basin. The average annual precipitation for the area is approximately 45 inches. In an average year about eight percent of the precipitation falls as snow.

A large amount of runoff data is available for the Monongahela Sub-Basin. Gaging stations have been maintained for many years at various locations along the main stream and tributaries. At present there are more than 40 such stations.

One of the water-stage recorders is located at Braddock, Pa., 11.2 miles upstream from the confluence of the Monongahela with the Allegheny River. The records for this location, above which lies a drainage area of 7,337 square miles, show a wide variation of flows. During the period from 1939 to 1947, the maximum discharge was 201,000 second-feet with a gage height of 31.20 feet. The maximum known gage height was 38.8 feet in March, 1936, for which the discharge in cubic feet per second has not been accurately determined.

The lowest daily flow on record at Braddock for the period between 1939 and 1947 was 703 cubic feet per second in September, 1946. The discharge at this point is controlled by the upstream operation of navigation locks and hydroelectric plants, and by four existing reservoirs in as many tributaries.

Major River Developments

Major existing dams are Tygart and Youghiogheny River Dams, for flood control and low-flow regulation, and Deep Creek and Lake Lynn Dams, for power and low-flow regulation. Lake Lynn Reservoir, located on Cheat River, and Deep Creek Reservoir are owned and operated by private concerns. The other two were constructed by the Army Corps of Engineers. In addition to these four, there are 13 navigation dams on the main stem which provide a navigation channel varying from 9 feet to 7 feet for the 128 miles from Pittsburgh to the head of the river. A new dam and locks being constructed near Morgantown, W. Va., will replace two existing locks and dams. Authorized improvements will provide a channel of 9-foot minimum depth to the head of navigation at Fairmont.

Included in the Corps of Engineers comprehensive plan for flood control and other purposes are 2 dams which have been authorized but on which construction has not been started. Several more projects have been recommended and others are classified as potential projects.

Population

The sub-basin had a 1940 population of about 1,502,600 of which approximately 38 percent was classified as rural. The combined population of those communities now recognized as significant sources of pollution was about 1,032,000 in 1940.

Water Uses

The Monongahela is one of the most important inland waterways in the nation. Storage is provided for water which is released as needed to provide for navigation along the entire length of the main stream, as well as in the lower stretches of some of the tributaries.

Another valuable use of the surface streams in the sub-basin is for municipal and industrial water supply. Surface water is used by 170 municipalities, 15 of which receive their water from the Allegheny River. The 155 communities using surface water from this sub-basin have a population of some 807,000 served by the public water systems. Numerous industries use surface waters in large amounts for manufacturing processes and for cooling purposes.

The watercourses are used for the disposal of industrial and municipal wastes. This use, heretofore inadequately controlled, conflicts with most of the other legitimate water uses of the area.

Other water uses include production of power and use for recreational purposes. The reservoirs constructed for power and flood control provide valuable recreational areas. Some of the tributaries in the eastern part of the sub-basin are still clean enough to allow fishing and bathing. Recreational uses in many areas are prohibited by the polluted condition of the streams.

Sources of Pollution

The State agencies concerned with pollution in the Monongahela River Sub-Basin have listed a total of 290 significant municipal sources of pollution. Of these, 171 communities, with a sewered population of about 880,000, discharge a pollution load with a population equivalent of approximately 820,000, as measured by the biochemical oxygen demand test. The latter figure represents the combined known domestic and industrial waste loads, treated and untreated, discharged to streams through municipal sewerage systems. Two small communities which have no public sewerage systems are discharging through private systems a waste load of some 1,600 population equivalent. Another community, though it has a sewerage system serving an unknown population, discharges a waste load of approximately 500 population equivalent from its sewage treatment works.

There are 116 other communities contributing an unknown waste load to the surface streams. Of these, 79, with no comprehensive public sewerage systems, have a combined population of about 35,300. There are 14 communities, 6 with and 8 without public sewerage systems, for which population data have not been obtained. The remaining communities have sewerage systems serving a combined population of approximately 95,100.

In addition to industrial wastes in municipal sewers, there is a large pollution load entering the streams of the valley from the private sewers of 138 industrial plants. Eleven of these discharge organic wastes with a population equivalent of 25,770, while 74 industries have an undetermined organic waste load. Inorganic wastes are discharged by 92 industries, including 48 also producing organic wastes. The types of wastes discharged by 9 plants have not been determined.

Acid mine drainage has long been one of the most important pollution problems in the Monongahela River Sub-Basin. The number of sources of this type of waste is unknown, but they are very numerous throughout the coal mining areas. The Ohio River Pollution Survey reported a decade ago that the acid load was then about 646,000 tons per year (calcium carbonate equivalent). This was the residual acid load after an ambitious mine sealing program undertaken in the 1930's. The amount has increased considerably since 1940 because of additional mines opened and because of a lack of maintenance on the seals of abandoned mines.

Effects of Pollution on Water Uses

Pollution in the Monongahela River valley has had very damaging effects on most of the water uses. Public water systems supplied from surface streams are forced to meet the additional expense of treating the polluted water to make it safe for human consumption. In some cases, municipalities and industries have had to develop water supplies located at some distance because more conveniently located streams were unfit for use.

Game fishing has been sharply curtailed in many of the streams receiving acid drainage from mines. The Maryland Water Pollution Control Commission reports that heavy fish kills occur annually in the upper reaches of the Youghiogheny River. Fish cannot survive in many streams where conditions of low dissolved oxygen or of high acidity prevail.

Bathing and other forms of outdoor recreation have also suffered from the use of the streams for waste disposal. Many areas are now useless for such purposes.

Even navigation is affected by pollution. High acidity of the streams causes considerable damage to the hulls of craft plying the Monongahela and the navigable stretches of the tributaries. The acid waters also attack the metal and concrete of bridges and waterfront installations.

Treatment Provided

Only a small portion of the sewered population of the sub-basin is served by sewage treatment works. There are 18 primary treatment plants, 17 of which serve a population of about 40,000; the population sewered to the other plant is unknown. A combined population of almost 57,000 is served by 22 secondary treatment plants. There are 250 communities that are considered to be significant sources of pollution but have no treatment. More than one-third of these do not yet have comprehensive public sewerage systems. Of those communities with no treatment facilities, 155 have a combined sewered population of about 878,000. The population of 81 of the unsewered communities is estimated at 37,000. Population figures have not been obtained for 8 unsewered and 6 sewered communities.

About one-fourth of the industrial plants provide treatment of wastes. Of the 138 industries in the sub-basin which discharge wastes to the streams through private sewers, only 36 provide some form of treatment. No treatment is provided by 99 industries, while no information on treatment has been obtained for 3 industries.

Treatment Plants Required

Table G_3 contains summary data relative to treatment plant requirements in the sub-basin. Table I_3 lists individual municipal and industrial projects. Extensive improvements are required to bring treatment facilities in the valley up to date. New plants are needed to serve 156 communities, 24 of which are expected to be sewered to a large plant to be constructed by the Allegheny County Sanitary Authority. Two other communities have agreed to combined treatment in a single plant. A population of some 848,000 is now sewered in 148 of the locations requiring new treatment facilities. Extensions of sewers in these towns will swell the population to be served by new plants. Seven communities with a total population of 6,052 and one town of unknown size are unsewered, and will require sewerage systems as well as treatment works.

Unsatisfactory water quality due to acid mine drainage has deterred the construction of municipal and industrial waste treatment plants, since there is little incentive to construct such works when the stream waters would still be unsuitable because of acid pollution.

Treatment plant enlargements or additions are required to adequately serve 4 communities with an aggregate population of almost 24,000. One town of 1,800 needs to replace its present inadequate plant. Disposal facilities are adequate at 15 locations with a combined population of 11,600 and at one town for which the population is unknown. Investigation is needed to determine the treatment needs of 26 communities with a sewered population of about 90,000, and of 74 unsewered communities with an estimated combined population of 31,000. Requirements are also undetermined for 6 sewered and 7 unsewered towns for which population data have not been obtained.

In the industrial category new treatment plants are needed to handle the wastes from 59 factories. Among the existing treatment plants, 7 require enlargements or additions and 6 other obsolete disposal plants should be replaced entirely. No project is required at 20 locations where satisfactory conditions

Table A_3. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	174[1] [2]	881,720[1]	821,145[1] [2]
Having population data available (Data on pollution load to watercourse incomplete or not available)	116[3] [4]	130,366[4]	Not applicable
Total	290	1,012,086	--

*Includes incorporated or unicorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 2 communities which have no comprehensive public sewerage system. These communities have an estimated combined population of 1,575.

[2] Includes one community for which data have not been determined.

[3] Includes 14 communities for which population data have not been determined, 8 of which have no comprehensive sewerage system.

[4] Includes 79 communities which have no comprehensive public sewerage system. These 79 communities have an estimated combined population of 35,333.

of waste disposal exist. The requirements at 46 industries are undetermined.

Tabular Data

The following tables include data on sources of pollution and related information for the Monongahela River watershed area. Coal mines, which are among the greatest sources of inorganic pollution, in the form of acid mine drainage, have not been tabulated. Additional investigation is required to determine the exact acid load from these sources, the effect on the streams, and the remedy.

Table B3. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	11**	25,770
Producing organic wastes	74[1]	Undetermined
Producing inorganic wastes	92	Not applicable
Producing wastes of undetermined type	9	Undetermined
Total	138[2]	--

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 2 plants also producing inorganic wastes.

[1] Includes 46 plants also producing inorganic wastes.

[2] Total adjusted to correct for duplication noted in footnotes marked thus, ** and thus, [1].

Table C3.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	18**	18	40,267
Secondary	22	22	56,760
No treatment	250[1] [2]	--	915,059[1]

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes one community for which population data have not been determined.

[1] Includes 89 communities having no comprehensive public sewerage systems. Of these, 81 have an estimated combined population of 36,908 and the population for 8 has not been determined.

[2] Also includes 6 communities having public sewerage systems for which population data have not been determined.

Table D3. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	18	7	11	0
Textile mill products......	1	0	1	0
Lumber and lumber products.	2	0	2	0
Products of petroleum and coal....................	8	5	3	0
Paper and allied products..	1	0	1	0
Leather and leather products................	2	2	0	0
Chemical and allied products................	4	2	0	2
Primary metal products.....	11	7	4	0
Fabricated metal products..	31	5	26	0
Coal washeries.............	13	1	12	0
Other mining industries....	5	2	3	0
Miscellaneous..............	39	4	35	0
Undetermined...............	3	1	1	1
Totals.................	138	36	99	3

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_3. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	40	25*	11	4	24	13	3
Industrial	36	13	15	8	12	16	8

*Some of the municipal plants located in Pennsylvania are considered satisfactory for the original design purposes. However, final determination of abatement requirements has not been made by the State Sanitary Water Board and additional treatment may be required. For this reason some of the plants listed as satisfactory in this table are listed as undetermined in tables G_3 and I_3.

Table F_3. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	--	0	--
1947	0	--	5	Undetermined
1948	0	--	1	Undetermined
1949	2	Undetermined	0	--

Table G_3. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number ** 1	Population served by facilities	Number ** 1
New plant	153[2]	853,810[2]	62
Enlargement or additions to existing plant	4	23,725	7
Replace existing plant	1	1,820	6
No project required	16[3]	11,625	20
Undetermined	113[4]	121,106[4]	46

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by other tables. See discussion under "Pollution Prevention Measures Required" part I of the report.

[2] Includes data for 8 communities having no comprehensive sewerage system. The estimated combined population of 7 of these communities is 6,052. Twenty-one of the municipalities have an agreement with the Allegheny County Sanitary Authority, Pa., to treat wastes at a central plant, and 2 others enter sewerage systems of cities having an agreement with the A.C.S.A. One municipality has an agreement with McKeesport, Pa., to combine sewage for treatment.

[3] Includes one community for which population data have not been determined.

[4] Includes 81 communities having no comprehensive public sewerage system. Of these, 74 have an estimated combined population of 30,856, and the populations of 7 have not been determined. Also includes 6 other locations for which population data have not been obtained. Also see note under table E_3.

Table H_3. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	59	34
Abatement ordered	10	18
Plans under preparation	46	37
Final plans approved	45	7
Construction awaiting financing	0	0
Under construction	4	3
Status undetermined	110	19

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served **	Project requirements	Remarks
West Virginia:			
Fairmont[1]	23,105	New plant	—
Fairmont Machinery Co.	--	New plant	Sanitary wastes only
Fairmont Aluminum Co.	--	New plant	Oil emulsions
Sharon-Steel Corp. (Fairmont)	--	Additions	Phenol recovery plant
Reilly Tar & Chemical Corp.	--	Additions	—
Millersville	225	Undetermined	(2)
Dakota	415	Undetermined	—
Rivesville[1]	1,552	New plant	—
Monongahela Power Co.	—	Undetermined	—
Catawba	300	Undetermined	(2)
Montana Mines	350	Undetermined	(2)
Jordan	400	New plant	—
Edna	190	Undetermined	(2)
South Union Coal Co.	—	New plant	Coal washing
Brady	100	Undetermined	(2)
National	350	Undetermined	(2)
Booth	504	Undetermined	(2)
Heyden Chemical Co. (operators for Government plant)	--	Undetermined	Phenolic and inorganic chemical wastes
Sharon Steel Corp.	--	Undetermined	Phenolic wastes
Suncrest	238	New plant	—
Morgantown[1]	26,000	New plant	—
Morgantown Glassware Guild	--	Undetermined	—
Seneca Glass Co.	--	Undetermined	—
Westover[1]	1,752	New plant	—
Riverside	1,043	New plant	—
Granville	1,017	New plant	—
Randall (Mona)	600	Undetermined	(2)
Star City[1]	1,175	New plant	—
Maidsville	600	Undetermined	(2)
Van Voorhis	120	Undetermined	(2)
Tasa Coal Company	--	New plant	Coal washing
Mannington[1]	3,155	New plant	—
Rachel	736	New plant	—
Farmington[1]	880	New plant	—
Jamison Coal & Coke Co.	—	New plant	Coal washing -- plans under preparation
Barrackville	962	New plant	—
Fairview[1]	831	New plant	—
Grant Town[1]	2,051	New plant	—
Eastern Gas & Fuel Association	—	New plant	Coal washing — plans under preparation
Baxter	1,017	Undetermined	(2)
Arnettsville	80	Undetermined	(2)
Everettville	643	New plant	—
Consolidation Coal Co.	—	New plant	Coal washing
Reedsville[1]	324	New plant	3 septic tank systems; 2 unsatisfactory
Preston Manufacturing Co.	--	Undetermined	—
Masontown[1]	900	New plant	—
Greer	100	Undetermined	(2)
Greer Limestone Co.	—	Undetermined	—

See footnotes at end of table.

Table I3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Dellslow	400	Undetermined	--
Richard	250	New plant	--
Sabraton	1,810	New plant	--
Sterling Faucet Co.	--	Undetermined	--
Morgan Shirt Company	--	Undetermined	--
Cassville	1,105	Undetermined	(2)
Christopher Coal Co. (Cassville)	--	New plant	Coal washing
Jere	582	Undetermined	(2)
Purglove	1,063	Undetermined	(2)
Christopher Coal Co. (Purglove)	--	New plant	Coal washing
Osage	864	Undetermined	(2)
Kelly Creek Colliery Co.	--	New plant	Coal washing
Monon Rail & River Coal Corporation	--	New plant	Coal washing
Rowlesburg[1]	1,452	New plant	--
Manheim	--	Undetermined	(2)
Alpha Cement Company	--	Undetermined	--
Albright[1]	334	Undetermined	(2)
Englehart Woolen Mill Company	--	Undetermined	--
Terra Alta[1]	1,471	New plant	--
Tunnelton[1]	552	New plant	--
Kingwood	1,676	New plant	--
Brandonville[1]	113	Undetermined	(2)
Bruceton Mills	165	Undetermined	(2)
Bemis	225	Undetermined	(2)
Parsons[1]	2,146	New plant	Plans for interceptors approved 1948
Dorman Mills	--	Undetermined	Dye wastes
Armour Leather Co.	--	Enlargement and additions	Tannery wastes. Plant under construction
Hambleton[1]	394	Undetermined	(2)
Davis[1]	1,454	New plant	(2)
Hendricks[1]	539	New plant	--
Thomas[1]	1,448	New plant	--
Coketon	500	Undetermined	(2)
Douglas	280	Undetermined	(2)
Pierce	500	Undetermined	(2)
Benbush	200	New plant	--
Job	184	Undetermined	(2)
Harman[1]	184	New plant	--
Whitmer	276	Undetermined	(2)
Blacksville[1]	261	New plant	--
Valley Head	576	Undetermined	(2)
Huttonsville[1]	308	New plant	(2)
Carnation Milk Company	--	Undetermined	--
Mill Creek[1]	732	New plant	--
Beverly[1]	484	New plant	--
Elkins[1]	8,135	New plant	Loan approved. Plans under preparation
Elkins Limestone Co.	--	Undetermined	--
Kistler Leather Co.	--	Additions	Now have lagoons and regulated discharge
Norton	539	New plant	--

See footnotes at end of table.

Table

West Vi
Junio
Bellin
Philip
Graftc
Hazel-
Clarks
Bluevi
Kingmc
Montrc
Coaltc
Ellamc
Buckha
Standa
Adrian
Centur
Volga.
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Table I_3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	**Remarks**
West Virginia--Continued			
Junior[1]	533	New plant	—
Bellington[1]	1,517	New plant	—
Philippi[1]	1,955	New plant	—
Grafton[1]	7,431	New plant	Acid mine drainage
Hazel-Atlas Glass Co.	—	Undetermined	—
Clarksburg Paper Co.	—	Undetermined	—
Blueville	635	Undetermined	(2)
Kingmont	500	Undetermined	(2)
Montrose[1]	122	Undetermined	(2)
Coalton[1]	417	Undetermined	(2)
Ellamore	519	Undetermined	(2)
Buckhannon[1]	4,450	New plant	Planning loan approved
Standard Trouser Co.	—	Undetermined	—
Adrian	605	Undetermined	(2)
Century	576	Undetermined	(2)
Volga	250	Undetermined	(2)
Pickens	600	Undetermined	(2)
Fellowsville	122	Undetermined	(2)
Evansville	48	Undetermined	(2)
Thornton	300	Undetermined	(2)
Newburg[1]	696	New plant	—
Pruntytown	300	Undetermined	(2)
W. Va. Reformatory for Boys	500	New plant	—
Walkersville	210	Undetermined	(2)
Weston[1]	8,268	New plant	Final plans approved
H. Bettis Company	—	Undetermined	—
C. A. Borchert Glass Co.	—	Undetermined	—
Louie Glass Co., Inc.	—	Undetermined	—
W. Va. Glass Specialty Company	—	Undetermined	—
Weston Glass Company	—	Undetermined	—
West Milfors	—	New Plant	(2)
Clarksburg[1]	30,579	New plant	Final plans approved
Pittsburgh Plate Glass Company	—	Undetermined	San. sewage only
Lang-Crist Box Co. Inc.	—	Undetermined	San. sewage only
Swift Company	—	Undetermined	—
Rolland Glass Company	—	Undetermined	—
Hazel-Atlas Glass Co.	—	Undetermined	—
Adamston Flat Glass Co.	—	Undetermined	—
Glen Falls	525	Undetermined	(2)
Dawnont	250	Undetermined	(2)
Hepzibah	519	Undetermined	(2)
Spelter	1,018	Undetermined	—
Meadowbrook Corp.	—	Undetermined	—
Meadowbrook	300	Undetermined	(2)
Gypsy	385	New plant	—
Shinnston[1]	2,817	New plant	—
Enterprise	858	Undetermined	(2)
Hutchinson	400	Undetermined	(2)
Worthington[1]	507	New plant	—
Monongah[1]	1,790	New plant	—
Watson	882	Undetermined	(2)
Jane Lew[1]	505	New plant	—
Lost Creek[1]	851	New plant	(2)

See footnotes at end of table.

Table I3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Mt. Clare	1,174	New plant	(2)
Craigmoor	36	Undetermined	(2)
Quiet Dell	90	Undetermined	(2)
Nutter Fort[1]	2,300	New plant	(2)
Anmoore	1,173	Undetermined	(2)
Norwood	565	Undetermined	(2)
National Carbon Co.	—	Undetermined	—
Despard	1,543	Undetermined	(2)
Pinnickinnich	515	Undetermined	(2)
Wolf Summit	500	Undetermined	(2)
Reynoldsville	567	Undetermined	(2)
Wilsonburg	150	Undetermined	(2)
Brownton	583	Undetermined	(2)
Galloway	980	Undetermined	(2)
Simpson Creek Collieries	—	New plant	Coal washing
Flemington[1]	690	New plant	(2)
Rosemont	607	Undetermined	(2)
Bridgeport[1]	1,581	New plant	—
Cooks Mine	—	Undetermined	(2)
Wendell	536	Undetermined	(2)
Jarvisville	225	Undetermined	(2)
Marshville	—	Undetermined	(2)
Sardis	100	Undetermined	(2)
Robey	25	Undetermined	(2)
Laura Lee	—	Undetermined	(2)
Excel Coal Company	—	New plant	Coal washing
Lumberport[1]	1,285	New plant	—
Salem[1]	3,000	New plant	—
W. Va. Industrial Home for Girls	275	New plant	—
Bristol	200	Undetermined	(2)
Wallace	776	Undetermined	(2)
Brown	400	Undetermined	(2)
Dola	200	Undetermined	(2)
Owings	517	New plant	—
Consolidation Coal Co.	—	New plant	Coal washing
Alliance	—	Undetermined	(2)
Margaret	—	Undetermined	(2)
Joetown	—	Undetermined	(2)
Grangeville	30	Undetermined	(2)
Oakdale	70	Undetermined	(2)
Wyatt	100	Undetermined	(2)
Pine Bluff	100	Undetermined	(2)
Four States	150	Undetermined	(2)
Maryland:			
Deer Park	250	New plant	—
Loch Lynn Heights	180	New plant	—
Mt. Lake Park	400	New plant	—
Oakland	1,500	New plant	—
Friendsville	150	New plant	—
Pennsylvania:			
L. J. Houze Convex Glass Company	—	New plant	Under construction
Point Marion	1,800	New plant	Plans under preparation

See footnotes at end of table.

Table 13. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
Pennsylvania—Continued			
Greenboro	625	New plant	[2]Final plans approved
Masontown	3,000	New plant	Final plans approved
Brownsville	7,000	New plant	Plans under preparation
West Brownsville	1,500	New plant	Plans under preparation
California State Teachers College	900	New plant	Plans under preparation
California	2,600	New plant	Plans under preparation
Elco	619	New plant	Plans under preparation
Moose Brewing Company	1,200	New plant	Plans under preparation
Roscoe	1,372	New plant	Plans under preparation
Stockdale	800	New plant	Plans under preparation
Pittsburgh Steel Co. (Allenport)	—	New plant	Acid pickling wastes. Plans under preparation
Allenport	400	New plant	Plans under preparation
Fayette City	1,600	New plant	Plans under preparation
Dunlevy	350	New plant	Plans under preparation
Speers	800	New plant	Plans under preparation
Belle Vernon	2,350	New plant	Plans under preparation
Charleroi	10,500	New plant	Final plans approved
Corning Glass Works	—	Replacement	Plans under preparation
North Charleroi	2,650	New plant	Plans under preparation
Pittsburgh Steel Co. (Monessen)	—	New plant	Plans under preparation
Monessen	18,000	New plant	Final plans approved
American Chain & Cable Company	—	New plant	Final plans approved
American Steel & Wire Company (Donora)	—	New plant	Acid wastes—abatement ordered
Donora	13,200	New plant	Abatement ordered
Combustion Engineering Corporation	300	New plant	Final plans approved
Liggett Spring & Axle Company	125	New plant	San. waste (classed with municipal) Final plans approved
Monongahela	7,800	New plant	San. waste (listed with municipal) Plans under preparation
New Eagle	1,929	New plant	Final plans approved
Elizabeth	2,500	New plant	Final plans approved
West Elizabeth	1,000	New plant	Plans under preparation
(Clairton) Carnegie-Illinois Steel Corporation	—	Enlargement	Plans under preparation
Copperweld Steel Co.	—	New plant	Abatement ordered
Glassport	8,750	New plant	Final plans approved
West Mifflin	4,000	New plant	Plans under preparation
Pittsburgh Airport	—	New plant	Plans under preparation
Carnegie-Illinois Steel Corp. (Irvin) No. 1	—	Replacement	Classified as industrial; plans under preparation
Carnegie-Illinois Steel Corp. (Irvin) No. 2	—	Enlargement	Acid pickling wastes; final plans approved

See footnotes at end of table.

Table I_3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
Pennsylvania--Continued			
Dravosburg..................	1,820	New plant	Plans under preparation
Allegheny County Housing Authority.........	—	(3)	—
National Tube Co.	—	Replacement	Abatement ordered
Fort Pitt Steel Casting Company...........	—	New plant	Plans under preparation
Firth Sterling Steel Company....................	—	New plant	Plans under preparation
Wood Works, Carnegie-Illinois Steel Corp.......	—	New plant	Plans under preparation
Duquesne....................	20,600	New plant	Plans under preparation
Duquesne Works, Carnegie-Illinois Steel Corporation.........	—	Replacement	Plans under preparation
North Braddock..............	15,679	(3)	—
Edgar Thompson Works, Carnegie-Illinois Steel Corporation..........	—	Replacement	Plans under preparation
Sterling Steel Foundry Company...........	—	New plant	Plans under preparation
Braddock....................	18,326	(3)	—
Whitaker....................	2,200	(3)	Through Munhall sewers
Rankin......................	7,470	(3)	—
Carnegie-Illinois Steel Co. (Rankin).........	—	Replacement	Plans under preparation
American Steel & Wire Company (Rankin)..........	—	New plant	Abatement ordered
Acheson Manufacturing Co....	—	(3)	—
Edgewood....................	4,700	(3)	—
Churchill...................	200	(3)	—
Wilkingsburg................	30,000	(3)	—
Munhall.....................	12,500	(3)	—
Homestead Works, Carnegie-Illinois Steel Corporation...............	—	New plant	Abatement ordered; acid pickling wastes
Homestead...................	19,900	(3)	—
Columbia Cleaning Co........	—	New plant	Soapy wastes--abatement ordered
Mesta Machine Co............	—	New plant	Plans under preparation
West Homestead..............	3,526	(3)	—
South Side Works, Jones & Laughlin Steel Corp.....	—	New plant	Abatement ordered
Dillworth Porter Div., Republic Steel Corp.......	—	New plant	Sanitary wastes (listed with municipal); plans under preparation
A. M. Byers Co..............	—	New plant	Acid and oil wastes; plans under preparation
Pittsburgh (part)...........	262,250	(3)	275,600 to Allegheny River 262,250 to Monongahela River 193,500 to Ohio River
C. G. Hussey Co.............	—	New plant	Oil, pickling and plating wastes; plans under preparation
Brave Village...............	150	New plant	Abatement ordered
Bobtown Village.............	1,820	Replacement	Final plans approved

See footnotes at end of table.

Table I3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served **	Project requirements	Remarks
Pennsylvania--Continued			
Mt. Morris	100	New plant	Abatement ordered
Carmichaels	100	New plant	Plans under preparation
Marianna	1,500	New plant	Plans under preparation
Clyde #2 and #3	1,100	New plant	Abatement ordered
Bonar Addition	500	New plant	Final plans approved
Clarksville	100	New plant	Abatement ordered
Equitable Gas Co.	—	New plant	Abatement ordered
Waynesburg	4,500	New plant	Plans under preparation
Melrose	150	New plant	Abatement ordered
Richmond Radiator Co.	—	New plant	Plans under preparation
North Union Township	2,000	New plant	Abatement ordered
Simpson Towel & Supply Co.	—	New plant	Under construction
Ellsworth	350	New plant	Plans under preparation
Bentleyville	1,000	New plant	Plans under preparation
Cokeburg	150	New plant	Abatement ordered
Finleyville	250	New plant	Plans under preparation
Clairton	16,000	(3)	—
Library	350	Enlargement	Plans under preparation
Koppers Company, Inc.	—	New plant	Plans under preparation
South Connellsville	2,628	New plant	Under construction
Connellsville	13,000	New plant	Final plans approved
A. Overholt & Co, Inc.	—	New plant	Abatement ordered
Dawson	780	New plant	Plans under preparation
Jones Brewing Co.	5,370	New plant	Plans under preparation
West Newton	2,200	New plant	Final plans approved
Eden Park and White Oak	2,000	New plant	Plans under preparation
Versailles	2,410	(4)	—
Port Vue	3,600	(3)	—
Kelsey-Hayes Wheel Co.	—	New plant	Plans under preparation
Christy Park Works, National Tube Works	—	New plant	Abatement ordered
McKeesport	57,000	New plant	Plans under preparation
Salisbury	100	New plant	Abatement ordered
Somerset	5,400	Enlargement	Final plans approved
Rockwood	850	New plant	Plans under preparation
Somerset County Home	675	Enlargement	Under construction
Confluence	800	New plant	Abatement ordered
Dunbar	400	New plant	Plans under preparation
Dunbar Corporation	—	New plant	Abatement ordered
Vanderbilt	500	New plant	Plans under preparation
The Duraloy Co.	—	New plant	Sanitary wastes classed as municipal; plans under preparation
Everson	1,600	New plant	Final plans approved
Mount Pleasant	5,282	New plant	Final plans approved
Will G. Keck	—	Undetermined	Abatement ordered
Bryce Bros. Company	—	Undetermined	Abatement ordered
Glick Bros.	—	Undetermined	Abattoir wastes; abatement ordered
E. B. Hostoffer	—	Undetermined	Abattoir wastes: plans under preparation
Smelko Bros.	—	Undetermined	Abattoir wastes: plans under preparation
Greensburg	16,000	New plant	Final plans approved
American Glass Corp.	—	New plant	Plans under preparation

See footnotes at end of table.

Table I₃. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
Pennsylvania--Continued			
Railway & Industrial Eng. Co.	--	New plant	Abatement ordered
Porcelier Mfg. Co.	--	New plant	Abatement ordered
Robert Shaw Thermostat Company	--	New plant	Pickling and plating wastes; abatement ordered
Youngwood	2,500	New plant	Final plans approved
Silvis Farms, Inc.	230	New plant	Dairy wastes; abatement ordered
South Greensburg	2,600	New plant	Final plans approved
Southwest Greensburg	3,000	New plant	Final plans approved
Liberty	1,080	New plant	Plans under preparation
Duquesne Slag Co.	--	New plant	Plans under preparation
Trafford	3,600	New plant	Plans under preparation
Carnegie-Illinois Steel Co. (Trafford)	--	New plant	Plans under preparation
Pitcairn Yards, Penn. Railroad Company	--	New plant	Plans under preparation
Pitcairn	6,100	(3)	--
Wall	1,100	(3)	--
East McKeesport	2,100	(3)	--
Westinghouse Air-Brake Co. (Wilmerding)	--	New plant	Plans under preparation
Wilmerding	5,500	(3)	--
North Versailles Township	1,000	(3)	--
A. B. Bldg. Westinghouse Corp. (Turtle Creek)	--	New plant	Plans under preparation
Turtle Creek	9,600	(3)	--
Chalfant	950	(3)	(2)
Forest Hills	4,270	(3)	--
Westinghouse Corp. (E. Pittsburgh)	--	New plant	Plans under preparation
East Pittsburgh	6,000	(3)	--
Fort Pitt Brewing Co.	--	New plant	Abatement ordered
Jeanette	17,300	Enlargement	Plans under preparation
Manor Dist., Inc.	--	Undetermined	Plant closed at present
Newton Copper Works, Westinghouse Electric Corporation	--	New plant	Plans under preparation
Linhart Brass Works, Westinghouse Electric Corporation	--	New plant	Plans under preparation
Baldwin Township	1,910	(3)	--
3 unnamed municipalities	3,025	New plant	(5)
29 unnamed municipalities	--	Undetermined	(5)
1 unnamed industry	--	New plant	(5)
1 unnamed industry	--	Enlargement	(5)
10 unnamed industries	--	Undetermined	(5)

Footnotes to Table I_3.

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is indicated in terms of population equivalent as measured by B. O. D.

[1] Incorporated municipalities in West Virginia.

[2] No comprehensive public sewerage system.

[3] Has entered into agreement with the Allegheny County Sanitary Authority to treat sewage at a central point.

[4] Has an agreement to treat sewage in proposed McKeesport plant.

[5] Locations noted thus[5] are located in Pennsylvania and are not indicated by name since final action to determine treatment requirements has not been taken by the Sanitary Water Board. All other locations in Pennsylvania which are listed in table I_3 have received orders to abate pollution. (See also note under table E_3).

BEAVER RIVER SUB-BASIN

General Description

The Beaver River is formed by the junction of the Mahoning and Shenango Rivers and flows almost straight south for a distance of about 21 river miles to its confluence with the Ohio River at Rochester, Pa. The sub-basin covers an area of about 3,145 square miles in northwestern Pennsylvania and northeastern Ohio. Of its total area, 1,785 square miles are in Pennsylvania and 1,360 are in Ohio. The three major tributaries to the Beaver, the Mahoning and Shenango Rivers and Connoquenessing Creek, drain about 1,100, 1,080 and 830 square miles, respectively. Much of the land in the sub-basin is fairly flat, particularly in the northern part. The southeastern part of the sub-basin is quite hilly, and the lower reaches of the Beaver River Valley are narrow and rugged. The average fall of the main rivers of the sub-basin is about three feet per mile, but in its last 5-1/2 miles of flow the Beaver River falls about 62 feet, an average of about 11-1/2 feet per mile.

Economic Development

The Beaver Sub-Basin is primarily an industrial region. Youngstown, Ohio, its largest city, is the center of one of the greatest iron and steel producing areas in the country, and the principal activities of the region center around this industry. The quarrying of high quality limestone and the allied manufacture of cement are also important industries in the sub-basin. Deposits of clay and shale support brick and other ceramic industries and, although commercial operations are not extensive, some oil and gas are produced in the lower Beaver Valley. Coal deposits, part of the Appalachian field, are found in the southern part of the sub-basin, but most of the seams are thin and the coal generally contains too much sulfur to be of highest quality. Although some coal is mined, production does not compete seriously with that of the neighboring territory around Wheeling, W. Va.

Other important industries in the area relate to the production of chemicals, lumber, glass and textiles. Agriculture, dairying and food processing are also of substantial importance.

Rainfall and Runoff

The average annual precipitation over the sub-basin is about 38 inches. The rainfall is distributed fairly uniformly, the headwater regions receiving an average of about 39 inches and the lower river areas about 36 inches. Data for 26 stream gaging stations in the sub-basin have been published by the U. S. Geological Survey. The average discharge of the Beaver River at Wampum, Pa., was 2,185 cubic feet per second for a period of 15 years (1932-47). The drainage area above this station is 2,235 square miles. The extreme minimum daily flow of record at the station was 97 cubic feet per second and occurred in the fall of 1933. At that time some measure of flow regulation was accomplished by Milton Reservoir with a capacity of about 30,000 acre-feet. Since that time three new reservoirs have been installed in the headwater areas. These reservoirs have a combined storage capacity below spillway crest of about 393,500 acre feet and are used for the multiple purposes of flood control, conservation, water supply and low flow regulation. The minimum flow of the Beaver at Wampum during the water year 1946-47 was 510 cubic feet per second.

A gaging station is maintained on the Mahoning River at Youngstown, Ohio. The average discharge of the Mahoning at this station was 813 cubic feet per second for a period of 26 years (1921-47). The extreme minimum daily flow of record was 30 cubic feet per second in August, 1930. Since that time two of the multiple purpose reservoirs referred to above have been put into operation above this station. The minimum daily flow for the water year 1946-47 was 202 cubic feet per second and occurred in December.

Major River Developments

Four major reservoirs are located on the Mahoning River or its tributaries and one is located on the Shenango River. Berlin Reservoir on the Mahoning River and Mosquito Creek Reservoir on a tributary of the Mahoning are Department of the Army, Corps of Engineers, projects. They have capacities of 91,150 and 104,100 acre-feet, respectively, and are operated for flood control, water supply, and low-water regulation. Milton Reservoir, located on the Mahoning River below the Berlin Reservoir, was built by the City of Youngstown and private interests for the purpose of augmenting flow of the Mahoning during periods of low flow. This reservoir has been in operation since about 1916 and has a capacity of 29,150 acre-feet. Meander Creek Reservoir, on a tributary of the Mahoning, is a project of the Mahoning Valley Sanitary

District. It has a capacity of 32,410 acre-feet and serves as a municipal water supply source for Youngstown, Niles, and two other smaller communities.

The only major reservoir on the Shenango River at the present time is Pymatuning Reservoir at the upper end of the river. This reservoir was built by the State of Pennsylvania for the purpose of augmenting the flow of the Shenango in order that downstream cities and industries would have an adequate supply of water during periods of low flow. The capacity of this reservoir is 188,000 acre-feet.

Two more reservoirs have been authorized as Corps of Engineers projects. They are the Eagle Creek Reservoir, to be located on a tributary to the Mahoning above Warren, and the Shenango River Reservoir, to be located on the Shenango River above Sharpsville. The pool of the latter will extend past Kinsman on Pymatuning Creek. Both of these reservoirs will be used for low-water regulations and flood control.

A number of small reservoirs with capacities ranging from 100 to 4,600 acre-feet are located on streams of the sub-basin. Their uses include water supply, recreation and flow regulation.

The Corps of Engineers has made investigations and reports relative to further development of the water resources. These studies included consideration of provision for navigation up the Mahoning River and across the divide to Lake Erie, and consideration of additional storage for multiple purposes in a summit reservoir at the headwaters of the Mahoning and Grand Rivers.

Population

The 1940 population of the Beaver River Sub-Basin was about 728,000. About two-thirds of this population was in the 22 communities classified as urban (population over 2,500) by the Bureau of the Census. The 1940 population of 50 of the 52 communities now listed as significant sources of stream pollution was 509,441. Population data for two communities are not available.

Water Uses

Surface waters are extensively used as sources for domestic and industrial water supplies and for waste disposal. Domestic water supply systems for some 35 communities use surface water as a source of all or part of their required water. These water supply systems serve a combined population of about 496,000. A number of these surface supplies, including the Meander Creek Reservoir which serves a population of about 186,000, are subject to pollution by sewage from upstream sources.

Tremendous quantities of water are used by the various industries in the sub-basin. In the 25-mile stretch of the Mahoning River between Warren and Lowellville, the amount of water drawn from the stream for industrial use exceeds the average flow of the river. Almost all of this water is used for cooling purposes and is returned to the stream unchanged except for its increase in temperature. Since the amount of water used is often greater than the flow of the stream, the temperature increases have a cumulative effect. During periods of low flow the temperature of the river water below Youngstown often exceeds 110° F.

Some of the reservoirs in the sub-basin are used extensively for recreational purposes. Smaller streams are also used for recreation by local residents. The heavy concentrations of population and industry along the main streams, however, make considerable portions of them unsuitable for this use.

There is no navigation on the streams except near the mouth of the Beaver where it is affected by backwater from the Ohio River.

Sources of Pollution

Fifty-two communities discharge significant amounts of wastes to the streams of the sub-basin. Of these, 38, with a combined population of about 415,400, discharge wastes with a B.O.D. population equivalent of about 346,700. Twelve communities, with sewerage systems serving a population of about 94,500, contribute wastes with an undetermined population equivalent. Data for population and population equivalent of wastes are incomplete for the two remaining sewered communities. Domestic wastes from more than half of the population of the sub-basin enter the Mahoning River in the 25-mile stretch between Warren and Lowellville.

Eighty-three industrial plants discharge wastes to the streams. Six produce organic wastes with a B.O.D. population equivalent of 36,750. Five more produce organic wastes with an undetermined population equivalent. Four of these last five plants also produce inorganic wastes. Seventy-two plants produce only inorganic wastes. Many tons of sulfuric acid in the form of waste pickle liquor from the metal industries are discharged to the streams each day. It has also been shown that large quantities of phenols have entered the Mahoning River in four different sections where by-product coke plants are located. Industrial waste sources, like population, are highly concentrated in the vicinity of Youngstown.

Effects of Pollution on Water Uses

The Mahoning and Beaver Rivers never fully recover from the extremely heavy pollution load received by the Mahoning in the vicinity of Youngstown. Public water supplies which use the Beaver River as a source are affected by all of the wastes entering the Mahoning as well as by the wastes entering the less heavily polluted Shenango River. Water from these supplies is often unpalatable even though it has received the most thorough and careful treatment. Phenol from the Youngstown area has at times caused great difficulty in the production of palatable water as far downstream as Beaver Falls.

The use and re-use of the waters of the Mahoning for cooling purposes increases the water temperature and results in accelerated decomposition of organic material and a decrease in the amount of oxygen the water can hold in solution. This dual effect aggravates the nuisance conditions along the stream. Complete oxygen depletion has been observed in the Mahoning at several points during surveys. The high temperature of the Mahoning also increases operating costs considerably for industries using it as a source for cooling water.

Much of the Mahoning is unsuitable for recreational use because of the heavy pollution and the concentrations of industry on its banks. The same is true to a lesser extent for portions of the Shenango River and most of the Beaver. Fish do not live in the portion of the Mahoning below Youngstown. Smaller tributary streams, for the most part, are relatively clean.

Treatment Provided

Treatment is provided for the domestic wastes from 38 of the 52 sewered communities in the sub-basin. Twenty communities provide primary treatment serving a population of about 146,000; 18 provide secondary treatment serving a population of about 90,000; and 14, with sewers serving a population of about 273,000, provide no waste treatment. Youngstown, the largest city in the sub-basin, provides no treatment and accounts for about three-fifths of the sub-basin's untreated domestic wastes.

Of the 83 waste-producing industrial plants, 45 have some kind of waste treatment facilities while 37 have none. The status of waste treatment at one plant has not been determined. Tables C_4, D_4 and E_4 present data relative to waste treatment in the sub-basin.

Treatment Plants Required

Table G_4 contains summary data relative to treatment plant requirements in the Beaver Sub-Basin. Table I_4 lists individual industrial and municipal projects. Thirteen municipalities require new treatment plants, seven require enlargement of or additions to existing facilities, and the requirements at 11 have not been determined. Forty industrial plants require new waste treatment facilities, eight require enlargement or additions to existing facilities and the requirements for 13 have not been determined. Twenty-one municipalities and 22 industrial plants require no waste treatment plant projects.

Tabular Data

Tables A_4 through I_4 contain data concerning water pollution in the sub-basin.

Table A_4. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people) **
Having data on pollution load discharged to watercourse	38	415,424	346,700
Having population data available (Data on pollution load to watercourse incomplete or not available)	14[1]	94,489	Not applicable
Total	52[1]	509,913	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Two locations included for which population data are not complete.

Table B_4. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	6	36,750
Producing organic wastes	5**	Undetermined
Producing inorganic wastes	76	Not applicable
Producing wastes of undetermined type	0	--
Total	83[1]	--

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 4 plants also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus, **.

Table C_4.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	20	20	146,203
Secondary	18	19	90,539
No treatment	14**	--	273,171

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes two communities for which population data are not complete.

Table D_4. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	4	1	3	0
Chemical and allied products....................	7	4	3	0
Products of petroleum and coal....................	6	5	0	1
Leather and leather products....................	1	0	1	0
Primary metal industries...	24	16	8	0
Fabrfcated metal products..	35	15	20	0
Miscellaneous.............	6	4	2	0
Totals..................	83	45	37	1

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_4. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	39*	21[1]	10	8	23	8	8
Industrial	45	24	17	4	37	4	4

*39 treatment plants serving 38 municipalities.

[1] 21 plants serving 20 municipalities.

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Table F₄. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	2	Undetermined
1948	2	Undetermined	2	Undetermined
1949	0	—	11	Undetermined

Table G₄. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**[1]	Population served by facilities	Number**[1]
New plant	13[2]	272,171	40
Enlargement or additions to existing plant	7	49,578	8
Replace existing plant	0	—	0
No project required	21[3]	109,744	22
Undetermined	11	78,420	13

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by other tables. See discussion under "Pollution Prevention Measures Required" Part I of the report.

[2] Includes 2 locations for which population data are incomplete.

[3] Includes one municipality served by two treatment plants.

Table H₄. Status of treatment works projects to abate pollution, July 1, 1950

Status of project *	Number	
	Municipal	Industrial
No formal action	2	49
Abatement ordered	0	0
Plans under preparation	10	10
Final plans approved	13	0
Construction awaiting financing	0	0
Under construction	0	1
Status undetermined	6	1

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I₄. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Pennsylvania:			
Rochester Township..........	500	New plant	Final plans approved
Sharon......................	27,000	Enlargement	Plans under preparation
Beaver Falls................	--	New plant	Plans under preparation
Evansburg...................	1,600	Enlargement	Final plans approved
Greenville..................	8,150	Enlargement	Final plans approved
Grove City..................	7,000	Enlargement	Final plans approved
Harmony.....................	850	Enlargement	Final plans approved
Babcock & Wilcox Tube Co....	--	New plant	Plans under preparation
Ingram-Richardson Co........	--	New plant	Plans under preparation
Moltrup Steel Products Co...	--	New plant	Plans under preparation
Townsend Co.................	--	New plant	Plans under preparation
Westinghouse Electric Co....	--	New plant	Under construction
Seamless Tube & Steel Co....	--	New plant	Plans under preparation
National Tube Co............	--	New plant	Plans under preparation
One unnamed industry........	--	New plant	(1)
Six unnamed industries......	--	Undetermined	(1)
11 unnamed municipalities...	--	Undetermined	(1)
Ohio:			
Appliance Manufacturing Co..	--	Undetermined	--
American Steel Foundries....	--	Undetermined	--
Transue & Williams Steel Forging Co.................	--	New plant	Pickling liquor wastes
The McKasky Register Co.....	--	New plant	Pickling liquor wastes
Alliance Manufacturing Co...	--	Undetermined	--
Alliance Ware Co............	--	New plant	Pickling liquor wastes
Babcock & Wilcox............	--	New plant	Pickling liquor wastes
Newton Falls................	3,120	New plant	--
Standard Steel Spring Co....	--	Enlargement	Plating and pickling wastes; plans under preparation
Warren......................	42,837	New plant	Final plans approved
General Electric Co. (Ohio Lamp Div.)................	--	Undetermined	--
The Thomas Steel Co.........	--	Enlargement	Pickling liquor wastes
Republic Steel Corp. (Steel mill).....................	--	Enlargement	(Warren) Pickling liquor wastes
Republic Steel Corp. (By-product coke plant).......	--	New plant	(Warren) Phenolic wastes; plans under preparation
Niles.......................	16,273	New plant	Final plans approved
Ohio Galvanizing & Manufacturing Co.................	--	New plant	Some pickling wastes
Stevens Metal Prod. Co......	--	New plant	Pickling liquor wastes
Niles Steel Products Co.....	--	New plant	--
Niles Rolling Mill Co.......	--	New plant	Pickling liquor wastes
Mahoning Valley Steel Co....	--	New plant	Pickling liquor wastes
Erie Refining Co............	--	New plant	--
McDonald....................	1,529	New plant	Final plans approved
Girard......................	9,805	New plant	Plans under preparation (Youngstown)
Youngstown Sheet & Tube Co. (Steel mill)..............	--	New plant	Pickling liquor (Youngstown)
Youngstown Sheet & Tube Co (Blast furnaces)..........	--	Enlargement	Gas washer water

See footnotes at end of table.

Table 14. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Ohio--Continued			
Youngstown Sheet & Tube Co. (Coke pit)	--	New plant	(Youngstown) Waste: 115,000 G.P.D.
Carnegie Steel Co.	--	New plant	Pickling liquor, cooling water
Youngstown	167,720	New plant	Plans under preparation
The Renner Co.	10,500	New plant	Brewery waste
Youngstown Hide & Tallow Co.	50	New plant	--
Youngstown Metal Prod. Co.	--	New plant	Pickling liquor (Youngstown)
Republic Steel Corp. (By-product coke)	--	New plant	Phenols; plans under preparation
Republic Steel Corp. (Steel Mill)	--	New plant	(Youngstown) Pickling liquor
Youngstown Sheet & Tube Co. (Steel plant)	--	New plant	(Campbell) Pickling liquor
Youngstown Sheet & Tube Co. (Blast furnace)	--	Enlargement	(Campbell) Gas washer water
Youngstown Sheet & Tube Co. (Coke plant)	--	New plant	(Campbell)
Campbell	13,785	New plant	Final plans approved
Struthers	11,739	New plant	Final plans approved
Youngstown Sheet & Tube Co. (Struthers)	--	Undetermined	Pickling liquor
Lowellville	2,359	New plant	Final plans approved
Sharon Steel Corp.	--	Enlargement	Gas washer water
Hiram	789	Additions	--
Garrettsville	1,264	New plant	--
McAllister's Dairy Farm	400	New plant	--
The Grinnel Co.	--	New plant	Cutting oil waste
Mullins Manufacturing Co.	--	New plant	Pickling acid and caustic wash solution
Brainard Rivet Co.	--	New plant	Pickling liquor
Van Huffel Tube Corp	--	Undetermined	Cooling water only
Niles Glass Works of G. E. Co.	--	Undetermined	--
E.I. DuPont de Nemours Co.	--	New plant	--
Wilders Manufacturing Co.	--	New plant	Pickling wastes
Ohio Leather Co.	24,500	New plant	--
Koppers Co.	--	New plant	Oil and tar wastes
Truscon Steel Co.	--	New plant	Pickling wastes
General Fireproofing Co.	--	New plant	Pickling and plating wastes
The Willcof Co.	--	New plant	Pickling wastes
Poland	1,240	New plant	--
General American Transportation Co.	--	Enlargement	Oils and fats; phenolic wastes
Hubbard	4,189	Additions	--
Youngstown Sheet & Tube Co. (Blast furnace)	--	Enlargement	(Hubbard)

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Organic industrial waste load is expressed in terms of population equivalent as measured by B.O.D.

[1] Sources of pollution in Pennsylvania which need corrective action are not listed by name unless formal action has been taken by the Sanitary Water Board. Abatement orders have been issued to all locations in Pennsylvania except those unnamed sources marked [1].

MUSKINGUM RIVER SUB-BASIN

General Description

The Muskingum River and its tributaries lie entirely within the State of Ohio and drain an area of 8,040 square miles, extending from the Ohio River to within 25 miles of Lake Erie, in the eastern portion of that State. The principal tributaries are the Licking, Walhonding, and Tuscarawas Rivers and Wills Creek. The Walhonding and Tuscarawas Rivers, draining 2,250 and 2,590 square miles, respectively, join at Coshocton near the center of the sub-basin, forming the main stream. The main stream flows southward for 112 miles and joins the Ohio River at Marietta, 172 miles downstream from Pittsburgh, Pa. Wills Creek drains an area of 853 square miles in the eastern portion of the Muskingum Sub-Basin, joining the main stream at a point 102 miles above its mouth. Draining the southwestern portion of the sub-basin, the Licking River has a watershed area of 780 square miles. The Licking River is about 30 miles in length, rising near Johnstown and joining the Muskingum at Zanesville, 77 miles above the confluence of that stream with the Ohio River.

The entire sub-basin is included in the Allegheny Plateau. The northern and western portions of the area were once covered by the continental ice sheet and there the land is relatively flat. The eastern and southern portion lies outside the glaciated area and is made up of rugged, hilly country with broad, flat-bottomed valleys in which flood plains and terraces are prominent. The total relief of the unglaciated area is approximately 500 feet.

Economic Development

The economic development of the Muskingum River Sub-Basin proceeded rapidly after 1800. With the construction of canals and the coming of railroads in the first half of the 19th Century, the extensive resources of the valley began to be exploited on an ever-increasing scale.

Among the natural resources of the area are bituminous coal, clays, shales, natural gas, limestone, sandstone, petroleum, salt, sand, and gravel. About one-third of Ohio's coal fields lie in the watershed. Clays having a high commercial value are plentiful and are used in manufacturing a variety of clay products. Petroleum and natural gas, though still important, are probably on the decline, as is often the case with these exhaustible resources.

Important industries are manufacturing, agriculture, coal mining, oil and gas production, and limestone quarrying. Transportation facilities have been developed to handle the products of these industries.

The abundant resources of the Muskingum River valley predict a prosperous future for it, and it may be counted upon to support an increasing population.

Rainfall and Runoff

The sub-basin has been well covered with rainfall gages for some time, the first gaging station having been established at Marietta in 1818. Rain gages are operated by the U. S. Weather Bureau, the Corps of Engineers, and the Soil Conservation Service.

The mean annual rainfall over the watershed, according to records of the U. S. Weather Bureau at 49 stations for periods ranging from 5 to 123 years, is 38.96 inches. In 1890, a wet year, 56.49 inches were recorded, while in 1930 only 25.35 inches fell on the area.

There are also a large number of stream flow gaging stations in the sub-basin where runoff is measured in the Muskingum River and its tributaries. Forty-five were being maintained in 1947. During the period 1921 to 1947, the flow at McConnelsville, the lowermost gaging station in the sub-basin, varied from a minimum of 218 cubic feet per second to a maximum of 126,000 cubic feet per second. The average discharge for this 26-year period has been 7,216 cubic feet per second, or slightly less than one cubic foot per second per square mile over the 7,411 square miles of drainage area above McConnelsville. Low flow records for various other points in the sub-basin are readily available in the publications of the U. S. Geological Survey.

Major River Developments

There are 14 dams on the Muskingum River and its tributaries. The storage provided by the reservoirs above these dams is used principally for flood control, but conservation pools are maintained at 11 of them, providing water for recreation, water supplies, and to augment flows during dry periods to provide increased dilution of domestic and industrial wastes. These dams were constructed by the Department of the Army, Corps of Engineers, in general accordance with the official plan of the Muskingum Conservancy District. The reservoirs have been included in the comprehensive flood control plan for the Ohio River Basin and are maintained and operated for that purpose by the Corps of Engineers.

Buckeye Lake, artificially created as a feeder for an early canal, is used now, and has been used for many years, for recreation purposes only. Also, Portage Lakes and Nimisila Lake are located on the headwaters of the Tuscarawas River.

One other flood control reservoir is under construction and two others are authorized in the comprehensive flood control plan of the Corps of Engineers.

Water power has not been developed on any large scale in the Muskingum River Sub-Basin. Numerous small water-power developments existed throughout the valley in 1880, but with the coming of efficient electrical power generation by steam and modern distribution, most of these plants have been abandoned. No large modern hydroelectric plants exist in the sub-basin, and none are planned. The topography, hydrology, and economy of the sub-basin are such that they do not favor water power. The Corps of Engineers has studied the possibility of water power development in the Muskingum watershed, and they have concluded that, under present conditions, hydroelectric power cannot compete with steam-electric energy derived from the low-cost coal found in the sub-basin.

The State of Ohio began construction in 1825 on an extensive system of canals. When completed, the system was used profitably until the coming of the railroads into the valley, beginning in 1837. A long period followed in which the use of the canals declined and locks and dams were allowed to deteriorate. Following the passage of a River and Harbor Act in 1886, the United States took over the locks and dams then in existence on the Muskingum River and began improving and restoring them. At the present time the existing system is obsolete and inadequate. A study is being made by the Corps of Engineers to determine the advisability of modernizing the navigation system on the river.

At present, none of the existing flood-control facilities are being operated for low-flow regulation, and any increased flows during dry periods is incidental. There is a conflict between the fluctuation of pool elevations resulting from low-flow control and the use of the reservoirs for recreational pursuits. The development of recreation on some of the reservoirs is considerable and these activities require a fairly constant pool level during the summer period. The possibility of increasing minimum flows with the existing and proposed impounding facilities should not be overlooked, however.

Population

The population of the Muskingum River Sub-Basin, according to the census figures, was 812,028 in 1940. About 451,500 of these lived in the 81 communities which are now listed by water pollution control agencies as contributing significant waste loads to surface streams in the sub-basin.

Water Uses

Most of the water used in the Muskingum River Sub-Basin for domestic and industrial purposes is from wells. Ground water in the area, though it is hard and often requires removal of iron, has been plentiful in the past. However, with expanding industries and increasing population, it is anticipated that more and more the crowded industrial areas will join the trend toward surface water supplies.

There are nine public water supplies obtaining water from surface streams at the present time. There are 68 communities with public water systems using ground water. The surface supplies serve an estimated 1950 population of 127,000, while the ground water systems now serve approximately 313,000. In addition, there are numerous small communities with both public and private supplies and using both ground and surface water sources. No population estimates for these towns are available.

Many industries in the valley have their own water supplies. Others depend on public systems for water used in their manufacturing processes. New processes are ever demanding increasing quantities of good quality water. Steam-electric plants in the sub-basin require an enormous amount of water containing a minimum of impurities.

Conservation pools are maintained in 11 of the existing flood-control reservoirs. These are used extensively for recreational purposes. Buckeye Lake and the Portage Lakes also furnish the area with good aquatic recreational facilities.

Sources of Pollution

The water pollution control agency in the State of Ohio has listed 81 communities as contributing significant waste loads to the Muskingum River and its tributaries. These communities have sewerage facilities which serve a population of approximately 510,000. About 469,000 of these persons live in 51 communities from which the pollution load to the streams amounts to a population equivalent of about 223,000. These data are presented in table A_5.

Also listed as waste contributors to the surface streams are 79 industrial plants. These are in addition to those industries which discharge their waste materials into public sewers. Both organic and inorganic wastes are discharged, the population equivalent of the former amounting to over 211,000, as measured by B.O.D.

The greatest concentration of industry and population lies in the northeastern section of this sub-basin, which is drained by the Tuscarawas River and its tributaries. In that area substantial waste loads are contributed by the cities of Barberton, Canton and Massillon, the latter two of which are centers for large steel mills which discharge considerable quantities of pickling liquors. In the southern part of this sub-basin along the Muskingum River are the cities of Coshocton, Dresden and Zaneville, which are also sources of considerable amounts of domestic and industrial wastes.

Effects of Pollution on Water Uses

The industrial area in the northeastern part of the sub-basin is drained by the Tuscarawas and its tributaries. The use of these streams as sources of water supply is greatly restricted by pollution. As yet, however, there is no great need to develop surface water supplies in the area. Game fishing is harmed considerably, and the water is reported to be unsatisfactory for livestock in many of the minor streams of the area.

Elsewhere in the Muskingum watershed the pollution problem is less acute. The higher stream flows on the main stem below Coshocton afford greater dilution of wastes, and the effects, though great enough to demand attention, are less severe than in the streams of lower flows.

Treatment Provided

Of the 41 communities served by treatment facilities, 18 have primary treatment and 23 have secondary treatment. Four of the latter are served by a single plant. The primary plants serve a population of approximately 143,000, while the secondary plants serve some 234,000. A combined population of about 133,000 are found in towns having no treatment provided.

Of the 38 municipal treatment plants in the valley, 23 are of satisfactory design, 12 are unsatisfactory, while the adequacy of the remaining 3 has not been determined.

There are 36 installations providing treatment of industrial wastes. Only one of these is of satisfactory design. Of the rest, 28 are unsatisfactory and 7 are in the undetermined category.

The efficiency of at least 6 municipal plants and 11 industrial treatment facilities could be increased by application of improved operation methods.

Treatment Plants Required

Table G_5 contains summary data relative to requirements for treatment facilities in the Muskingum River Sub-Basin. Table I_5 lists individual municipal and industrial projects. In the municipal category, 43 new plants, 10 enlargements or additions to existing plants, and 7 plant replacements are required. One of the 7 replacement plants will serve 4 municipalities. No projects are required at 18 locations.

Proper treatment of industrial wastes in the valley will require 43 new plants, 10 enlargements or additions, and 18 replacements of existing facilities. The requirements at 8 industries have not been determined as yet.

Tabular Data

Additional data relative to pollution in the Muskingum River Sub-Basin are found in tables A_5 through I_5. Data for Marietta, Ohio, located at the mouth of the Muskingum River, are included with data for the Ohio River Mainstem Sub-Basin and not with the tabular data for the Muskingum.

Table A_5. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	51	468,653	222,668
Having population data available (Data on pollution load to watercourse incomplete or not available)	30[1]	41,147[1]	Not applicable
Total	81[1]	509,800[1]	--

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 20 communities having no comprehensive public sewerage systems, but for which population data are available. These 20 communities have an estimated combined population of 17,256.

Table B_5. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	46**	211,250
Producing organic wastes	4	Undetermined
Producing inorganic wastes	34	Not applicable
Producing wastes of undetermined type	1	Undetermined
Total	79[1]	--

*Industries having separate outlets and discharging directly to watercourse.

**Includes 6 plants also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus,**.

Table C_5. Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	18	18	142,621
Secondary	23	20[1]	234,160
No treatment	40[2]	--	133,019[2]

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

[1] Includes one treatment plant serving four communities.

[2] Includes 20 communities having no comprehensive public sewerage systems. Estimated combined population of these 20 communities is 17,256.

Table D_5. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having: Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	35	13	22	0
Textile mill products......	1	0	1	0
Lumber and wood products...	1	1	0	0
Paper and allied products..	5	1	4	0
Chemicals and allied products.................	3	2	1	0
Products of petroleum and coal.................	5	5	0	0
Rubber products............	3	1	2	0
Leather and leather products.................	1	0	1	0
Primary metal industries...	13	10	3	0
Fabricated metal products..	4	1	2	1
Mining......................	1	0	1	0
Miscellaneous..............	7	2	5	0
Totals..................	79	36	42	1

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_5. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to: Capacity: Satisfactory	Unsatisfactory	Undetermined	Operation: Satisfactory	Unsatisfactory	Undetermined
Municipal	38*	23	12*	3	28	6	4
Industrial	36	1	28	7	18	11	7

*Includes one treatment plant serving four communities.

Table F_5. Progress in pollution abatement

Year	Municipal: Plants completed	Design population	Industrial: Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	1	Undetermined
1947	0	—	2	Undetermined
1948	0	—	0	—
1949	1	40,000	0	—

Table G_5. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**[1]	Population served by facilities	Number**[1]
New plant	43[2]	143,569[2]	43
Enlargement or additions to existing plant	10	162,906	10
Replace existing plant	10[3]	165,543	18
No project required	18	37,782	0
Undetermined	0	--	8

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by preceding tables. See discussion under "Pollution Prevention Measures Required", Part I of the report.

[2] Includes 20 communities having no comprehensive sewerage systems, but for which population data are available. These 20 communities have an estimated combined population of 17,256.

[3] Includes Canton and 3 other municipalities tributary to Canton sewage treatment plant.

Table H_5. Status of treatment works project to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	33	72
Abatement ordered	0	0
Plans under preparation	0	2
Final plans approved	9	0
Construction awaiting financing	0	0
Under construction	7**	0
Status undetermined	14	5

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

**Includes 6 municipalities tributary to 2 treatment plants. Canton and 3 other municipalities are tributary to Canton sewage treatment plant and 2 other municipalities tributary to one treatment plant.

Table I_5. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Ohio:			
Coshocton	12,000	New plant	Final plans approved
Carnation Milk Co.	3,900	New plant	--
Muskingum Fibre Products Co.	58,000	New plant	--
Stone Container Corp.	31,000	New plant	--
Dresden	1,350	New plant	--
Dresden Paper Mills	50,000	New plant	--
Zanesville	37,500	New plant	--
American Rolling Mills	--	Additions	Pickling wastes
C. Findeiss Sons Co.	8,000	New plant	Tannery
South Zanesville	1,338	New plant	Final plans approved
McConnelsville	1,895	New plant	--
Finley Packing Co.	1,700	Undetermined	--
Malta	938	New plant	No community sewerage system
The United Dairy Co.	600	New plant	--
Ashland	13,500	Additions	Population figure does not include P.E. of industrial wastes to storm sewers
Cleveland Dairy Products	200	New plant	--
Jeromeville	474	New plant	--
West Salem	700	New plant	No community sewerage system
Shelby	6,643	Replacement	--
Shelby Spring Hinge Co.	--	Undetermined	Cyanide and nickel salt waste
Ohio Seamless Tube Co.	--	Additions	Pickling wastes
Shelby Cycle Co.	--	Undetermined	Pickling wastes
Loudenville	2,334	New plant	Final plans approved
Cottage Creamery	300	New plant	--
Mansfield	42,000	Additions	Population figure does not include P.E. of industrial wastes to storm sewers
W. A. Kearns Packing Co.	2,000	New plant	--
Mansfield Tire and Rubber Co.	500	New plant	--
Ohio Brass Co.	--	New plant	Pickling wastes
Empire Sheet & Tinplate Co.	--	New plant	Pickling wastes
Carnation Co.(Belleville)	400	Undetermined	--
Mt. Vernon	14,000	Replacement	Final plans approved
Millwood Sand Co.	--	New plant	Acid wastes
Danville	790	New plant	No community sewerage system
Creston	1,110	New plant	No community sewerage system
Gertenslager & Co.	500	Additions	Slaughterhouse
Timken Roller Bearing Co.	--	Additions	Pickling wastes
Shreve	1,113	Additions	Final plans approved
Millersburg	2,249	New plant	Fianl plans approved
Killbuck	716	New plant	--
Leroy	254	Additions	--
Apple Creek	510	New plant	No community sewerage system
Bunker Hill Cheese Co.	200	Replacement	--

See footnotes at end of table.

Table I_3. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Ohio—Continued			
Sharp Run Dairy.............	200	Replacement	—
Glenmont.....................	281	New plant	No community sewerage system
Charm Cheese Co.	150	Replacement	—
E. J. Miller Cheese Co.......	150	Replacement	—
Barberton....................	25,000	Additions	—
Columbia Chemical Division of Pittsburg Plate Glass Co..........................	—	New plant	—
Canal Fulton.................	1,115	New plant	—
Massillon....................	43,000	Additions	—
Eaton Mfg. Co.-Plt. #1	—	Undetermined	—
Republic Steel Corp., Union Drawn Division......	—	New plant	(Massillon)
Republic Steel Corp. (Central Alloy Division) Steel Mill................	—	New plant	(Massillon)
Republic Steel Corp. By-Product Coke Plant.........	4,700	Replacement	(Massillon)
Republic Steel Corp. Blast Furnace.............	—	Replacement	(Massillon)
Navarre......................	1,703	Additions	—
Mineral City.................	820	New plant	—
Dover........................	9,691	New plant	—
Greer Steel Co...............	—	New plant	Pickling wastes
Reeves Steel & Mfg. Co.	—	New plant	Pickling wastes
Reilly Tar & Chemical Co....	300	Additions	—
W.C. Hardesty, Inc...........	—	New plant	Fatty acids
Dover Appliance Co...........	—	New plant	Electroplating wastes
New Philadelphia............	12,328	New plant	—
Walter Graf & Son............	300	New plant	Slaughterhouse
Newcomerstown................	4,564	New plant	—
Seiberling Rubber Co.........	—	Undetermined	—
Midwest Rubber Co............	9,000	Replacement	—
Pitts. Valve Division of Pitcairn Company..........	—	New plant	Acid wastes
Seville......................	850	New plant	—
Farmers Dairy Prod. Co......	300	New plant	—
Orrville.....................	5,000	New plant	Final plans approved
Wood Preserving Co..........	—	Additions	Phenolic wastes
Wadsworth....................	7,500	Replacement	—
Ohio Match Co................	—	Additions	—
Rittman......................	2,800	Replacement	—
Morton Salt Co...............	—	Replacement	Brine
Ohio Boxboard Co.............	20,000	Enlargement	Plans under preparation
Dalton.......................	774	New plant	—
Ecko Products Co. (Massillon)................	—	New plant	Electroplating wastes
Minerva......................	2,937	Additions	—
Republic Steel Corp., Steel Mill................	—	New plant	Pickling wastes (Canton)
Republic Steel Corp., By-Product Coke Plant.....	6,000	Replacement	(Canton)
Republic Steel Corp., Blast Furnace.............	—	Enlargement	(Canton)

See footnotes at end of table.

Table I_5. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Ohio--Continued			
Canton Refining Co.	—	Replacement	Oil
Republic Steel Corp., Spark & So. Div.	—	Replacement	Pickling wastes
Canton Stamping & Enameling Co.	—	Replacement	Pickling wastes
Canton	130,000	Replacement	(Canton) plant under construction
North Canton			Tributary to Canton sewage treatment plant
East Canton			
Meyers Lake			
Timken Roller Bearing	--	Replacement	Plans under preparation; pickling wastes
Louisville	4,200	New plant	Under construction
Superior Sheet Steel Co.	--	Replacement	Acid wastes
Jewett	1,031	New plant	No community sewerage system
Scio	1,181	New plant	No community sewerage system
Bowerston	447	New plant	No community sewerage system
Smithville	617	New plant	No community sewerage system
Sheller Bros.	150	Additions	—
Brewster	1,600	Replacement	—
Alpine Cheese Co.	300	New plant	—
Ragersville Cheese Co.	200	Replacement	—
Baltic	492	New plant	No community sewerage system
Baltic Cheese Co.	300	Replacement	—
Sugar Creek	836	New plant	No community sewerage system
Pleasant View Dairy	200	New plant	—
Union Cheese Co.	150	New plant	—
Sugar Creek Dairy	300	New plant	—
Valley View Dairy	200	New plant	—
Carnation Co. (Sugar Creek)	400	New plant	—
Mast Dairy	250	New plant	—
Farmerstown Cheese Co.	200	New plant	—
Champion Dairy	200	Replacement	—
Lantzer Dairy	200	New plant	—
Gerber Valley Cheese Co.	150	New plant	—
Orville Milk Condensing Co.	300	New plant	—
Yaggi Dairy	150	New plant	—
Eckert Dairy	200	New plant	—
Freeport	562	New plant	No community sewerage system
Dennison	4,413	New plant	One plant to serve both under construction
Uhrichsville	6,435	New plant	
Flushing	1,217	New plant	No community sewerage system
Holloway	733	New plant	No community sewerage system
Bakersville Cheese Factory	200	Undetermined	—

See footnotes at end of table.

Table I_5. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1,1950--Continued

Name	Population served**	Project requirements	Remarks
Ohio--Continued			
Cambridge....................	15,044	New plant	Final plans approved
Kimbolton....................	214	New plant	No community sewerage system
Pleasant City................	563	New plant	No community sewerage system
Broughton Farm Dairy.........	250	New plant	--
Cambridge Glass Works........	--	Undetermined	--
Bush Woolen Mills............	1,200	New plant	--
Newark.......................	32,600	Additions	--
David Divies Co.	7,200	New plant	Meat packing
Rittberger Bros.	150	New plant	Meat packing
Granville....................	3,000	Replacement	Includes Dennison University; final plans approved
Pataskala....................	824	New plant	No community sewerage system
Buckeye Lake.................	500	New plant	Summer resort
Hebron.......................	723	New plant	--
Pure Oil Co.	--	Replacement	Oil wastes
Granville Paper Co.	--	New plant	--
Centerburg...................	799	Additions	--
Crooksville..................	2,890	New plant	No community sewerage system
Roseville....................	1,320	New plant	No community sewerage system

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Organic industrial waste load is expressed in terms of population equivalent as measured by B.O.D.

LITTLE KANAWHA RIVER SUB-BASIN

General Description

The Little Kanawha Sub-Basin, located entirely in west central West Virginia, comprises some 2,320 square miles of mountainous country. The main stream flows in a general northwesterly direction, emptying into the Ohio River at Parkersburg, W. Va. Tributaries to the main stream are the Hughes River, West Fork, Leading Creek and Steer Creek. The main stream is about 150 river miles in length and drops from an elevation of about 1,200 feet at its headwaters to about 560 feet at its mouth. The river drops only about 130 feet in its last 100 miles of flow. Although Parkersburg, W. Va., is located partially in the sub-basin, no data for the domestic wastes of the city are included with the data for this sub-basin. These data are included in the data for the main stem of the Ohio River.

Economic Development

The principal economic pursuits in the sub-basin are agriculture, gas and oil production, and bituminous coal mining. Farming is considered the major occupation but is limited to some extent by rough terrain. The production of oil and gas is declining. The mining of coal, for the most part, is limited to the eastern part of the sub-basin. General manufacturing operations are of little significance in the sub-basin except in the vicinity of Parkersburg.

Rainfall and Runoff

The average annual rainfall in the Little Kanawha drainage area is about 45 inches, ranging from about 40 inches near the mouth to about 50 inches in the headwater area. Gaging stations have been maintained at 9 locations on the Little Kanawha River and its tributaries. No flow records are available for the river downstream from its major tributaries, but flow records are available for the Little Kanawha at Grantsville and the downstream tributaries, West Fork at Rockdale and Hughes River at Cisco. The average discharge of the main stream at the Grantsville station for a period of 18 years (1929-47) was 1,314 cubic feet per second from a drainage area of 913 square miles. Average discharge from the West Fork at the Rockdale station was 230 cubic feet per second for a period of 11 years (1929-31, 1938-47) from a drainage area of 452 square miles. Thus, the average runoff from 1,570 of the 2,320 square miles of the sub-basin is about 2,080 cubic feet per second. An extended period of no flow was observed at the three stations named above during September, October and November of 1930.

Major River Developments

A series of 5 locks and dams maintains a navigation channel for boats of 4-foot draft as far as Creston, 48 miles above the mouth on the main stream. These facilities are not used extensively and are now considered obsolete; their abandonment is being considered. Three flood control reservoirs in the sub-basin have been authorized as Corps of Engineers projects. The reservoirs, not yet under construction, will be located on the West Fork above Creston, on the Kanawha River above Burnsville, and on Steer Creek. The Steer Creek reservoir dam will be located about two miles above the mouth of the stream.

Population

The 1940 population of the sub-basin was 92,355. The entire 1940 population was classified as rural. The largest community, Spencer, had a population of 2,497, and the minimum population for which a community is classified as urban by the Bureau of Census is 2,500. The combined 1940 population of the 18 communities contributing significant amounts of waste to the streams was about 11,450.

Water Uses

Five communities use surface streams of the sub-basin as sources for public water supplies which serve a total population of about 7,500. The main stream, from its mouth to Creston, is used to a limited extent for navigation, and considerable use is made of the streams for recreational purposes. Both forks of the Hughes River and the main stream above Creston are considered good bass fishing streams and are used extensively for sport fishing.

Sources of Pollution

Eighteen communities contribute to the streams of the sub-basin the domestic wastes from a combined population of about 9,600 persons. Seven industrial plants discharge wastes to the watercourse. One of these contributes wastes with a B.O.D. population equivalent of 104,000, two produce organic wastes with an undetermined population equivalent, two produce some inorganic wastes, and three produce wastes of undetermined type.

Effects of Pollution on Water Uses

Streams of the sub-basin are not extensively damaged by pollution. Pollution damage which does occur is generally local in character and is more pronounced during periods of low flow. The industrial plant listed as producing wastes with a population equivalent of 104,000 is located at Parkersburg, near the mouth of the river, so does not materially affect the major portion of the stream.

Treatment Provided

Two primary treatment plants in two municipalities serve a combined sewered population of about 2,300. One municipality has secondary treatment facilities which serve a population of about 1,800, and 15 communities, with sewerage facilities serving a population of about 5,500, provide no treatment. Of the seven industrial plants, one provides treatment for inorganic wastes and one has no treatment facilities. The treatment status of five is undetermined. The previously mentioned industry located in Parkersburg is scheduled to provide treatment by July 1951.

Treatment Plants Required

Table G_6 contains summary data relative to treatment plant requirements for the sub-basin. Table I_6 lists individual municipal and industrial projects. Seven new plants and one plant addition are required at municipal sources of pollution. The requirements for 10 communities have not been determined. One industrial plant requires new treatment facilities, while the requirements for five more have not been determined.

Tabular Data

Tables A_6 through I_6 contain data relative to water pollution in the sub-basin.

Table A_6. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people) **
Having data on pollution load discharged to watercourse	6	3,670	3,670
Having population data available (Data on pollution load to watercourse incomplete or not available)	12[1]	5,942[1]	Not applicable
Total	18[1]	9,612[1]	--

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 9 communities having no comprehensive public sewerage system but for which population data are available. These 9 communities have an estimated combined population of 1,842.

Table B_6. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	1**	104,000
Producing organic wastes	2	Undetermined
Producing inorganic wastes	2	Not applicable
Producing wastes of undetermined type	3	Undetermined
Total	7[1]	--

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes one plant also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus, **.

Table C_6.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	2	2	2,300
Secondary	1	1	1,800
No treatment	15**	--	5,512**

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes 9 communities having no comprehensive public sewerage system, but for which population data are available. These 9 communities have an estimated combined population of 1,842.

Table D_6. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	2	0	0	2
Chemical and allied products....................	1	0	1	0
Stone, clay, and glass products................	1	1	0	0
Undetermined..............	3	0	0	3
Totals...................	7	1	1	5

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_6. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	3	1	2	0	3	0	0
Industrial	1	0	0	1	0	0	1

Table F_6. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	0	—	0	—
1949	0	—	0	—

Table G_6. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	7[1]	4,570	1
Enlargement or additions to existing plant	1	1,400	0
Replace existing plant	0	—	0
No project required	0	—	1
Undetermined	10[2] [3]	3,642[2]	5

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Includes one municipality listed in table E as having unsatisfactory treatment. The requirement is a new plant to treat sewage from the entire community.

[2] Includes data for 9 communities having no comprehensive public sewerage system, but for which estimates of population are available. These 9 communities have an estimated combined population of 1,842.

[3] Includes one municipality listed in table E as having satisfactory treatment under existing conditions.

Table H_6. Status of treatment works project to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	5	0
Abatement ordered	0	0
Plans under preparation	0	1
Final plans approved	1	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	12	5

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_6. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served **	Project requirements	Remarks
West Virginia:			
Burnsville[1]	250	New plant	—
Sand Fork[1]	252	Undetermined	No community sewerage system
Glenville[1]	1,300	New plant	—
Grantsville[1]	1,020	New plant	—
Palestine	50	Undetermined	No community sewerage system
Elizabeth[1]	600	New plant	—
Parkersburg[1] [2]	—	—	—
American Viscose Corp.	104,000	New plant	Plans under preparation
Casto Co.	—	Undetermined	—
Graham Packing Co.	—	Undetermined	—
Flatwoods	308	Undetermined	No community sewerage system
Copen	200	Undetermined	No community sewerage system
Troy	133	Undetermined	No community sewerage system
Spencer[1]	1,800	Undetermined	Has secondary plant
Reedy[1]	100	New plant	—
Pennsboro[1]	1,400	Additions	—
Myles Manufacturing Co., Pennsboro	—	Undetermined	—
Harrisville[1]	900	New plant	Final plans approved
Myles Manufacturing Co., Harrisville	—	Undetermined	—
Cairo[1]	400	New plant	—
Smithville	250	Undetermined	No community sewerage system
Auburn[1]	168	Undetermined	No community sewerage system
Pullman[1]	204	Undetermined	No community sewerage system
Ellenboro[1]	277	Undetermined	No community sewerage system
United Dairy Products	—	Undetermined	—

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these needs.

**Organic industrial waste load is expressed in terms of population equivalent as measured by B.O.D.

[1] Incorporated municipalities in West Virginia.

[2] Parkersburg and South Parkersburg are now combined and incorporated as the City of Parkersburg. Sewage is discharged to the Ohio River and to the Little Kanawha River near its mouth. Tabular data for this city are not included with other data for the Little Kanawha Sub-Basin, but are included with data for the Ohio River, Main Stem, Sub-Basin.

HOCKING RIVER SUB-BASIN

General Description

The Hocking River Sub-Basin is located entirely within the southeast portion of the State of Ohio, is roughly rectangular in shape and runs in a southeasterly direction. The total area of the sub-basin is approximately 1,185 square miles. The topography of the sub-basin, except in the glaciated headwater area, is generally hilly with moderately steep slopes. The headwater area is characterized by low, gently sloping hills and broad, flat valleys.

Economic Development

The principal economic pursuits of the sub-basin are agriculture, ceramic manufacturing, coal mining, and gas and oil production. The principal agricultural incomes are derived from dairying and raising of cattle and poultry. Fruit growing also represents a large proportion of agricultural income. Because of the deposits of commercial clay and coal found in the sub-basin, the ceramic manufacturing industry has developed quite extensively. Among the articles manufactured are brick, building tile and electrical conduits. Some coal mining is carried on in the sub-basin at the present time, although the total tons mined has declined quite markedly due to displacement from markets by superior West Virginia and Kentucky coals. A small amount of oil and gas is produced in the sub-basin.

Rainfall and Runoff

The average annual precipitation over the sub-basin is 40.5 inches. The geographical distribution of the annual precipitation varies only slightly. Available stream flow data indicate that the average discharge of the Hocking River at its mouth is slightly more than 1,200 cubic feet per second. However, minimum daily flows of 10 cubic feet per second have been received at Athens, which receives the drainage from 944 square miles.

Major River Developments

The only major river development in the Hocking River Sub-Basin is the Burr Oak Dam, constructed by the Department of the Army, Corps of Engineers, in cooperation with the State of Ohio. This dam, located on the East Fork of Sunday Creek, will be used as a flood control and water supply dam. The dam has been completed and impoundment of waters is expected to start early in 1951. One other flood control and low water regulation reservoir is authorized in the comprehensive plan of the Corps of Engineers. Two small gristmills, operating with low heads, are on the main stem of the river. They are located at Coolville and Athens and operate with heads of seven and nine feet, respectively.

Population

The 1940 population of the sub-basin was approximately 114,000. Of this number, about 58,500 resided in communities discharging wastes directly to streams.

Water Uses

Only three communities, serving approximately 9,900 people, use surface water supplies. Other uses of surface water are for stock watering and game fishing.

Sources of Pollution

There are 16 communities in the sub-basin which are considered sources of significant pollution. Eight of these, with a population of 10,300, have no comprehensive public sewerage system, and the actual amount of pollution contributed to the streams by these eight towns is unknown. Another town, though it has a sewerage system serving some 5,000 persons, has not been studied as to the amount of waste discharged to the watercourse. Seven communities with a combined sewered population of 45,700 are discharging, after some treatment, wastes equivalent to a population of about 20,000.

Industrial wastes with a population equivalent of 7,200 are discharged without treatment by three industries with private sewer outfalls. The amount of wastes discharged by industries to municipal sewers has not been determined. Acid wastes from mines has caused damage in many of the tributaries of the Hocking River. There is no recent estimate of the acid load going into surface waters in the sub-basin, but in 1940, according to the Ohio River Pollution Survey, the amount of acid load was estimated at 124,400 tons per year (calcium carbonate equivalent).

Effects of Pollution on Water Uses

The major pollution problems in the Hocking River Sub-Basin consist of local nuisance problems below communities where sewage is discharged directly into the stream and of acid conditions in many of the tributaries due to mine drainage. Damages exist to fish life and to recreational uses and the development of full use of the streams in the sub-basin is restricted.

Treatment Provided

Of the 16 communities listed as significant sources of pollution, two, with a sewered population of about 1,700, provide primary treatment. Three towns provide secondary treatment for an estimated combined population of approximately 28,100. There are 11 significant municipal sources of pollution with no treatment provided. Eight of these, with an estimated total population of 10,300, have no comprehensive public sewerage systems.

None of the industries with private sewer outfalls are treating wastes at present.

Treatment Plants Required

Table G_7 contains summary data relative to treatment plant requirements in the sub-basin. Table I_7 lists individual municipal and industrial projects. Eleven new treatment plants are required to serve the eleven communities now having no treatment. Three industrial plants require new treatment facilities to process wastes now receiving no treatment.

Tabular Data

Tables A_7 through I_7 present additional data on stream pollution in the sub-basin. Tables B_7 and D_7 do not include those active or abondoned mines which are sources of acid drainage. Additional data are required relative to the quantity of effects on and abatement requirements for mine drainage pollution.

Table A_7. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	7	45,695	19,810
Having population data available (Data on pollution load to watercourse incomplete or not available)	9[1]	15,714[1]	Not applicable
Total	16[1]	61,409[1]	--

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 8 communities having no comprehensive public sewerage systems, but for which population data are available. These 8 communities have an estimated combined population of 10,346.

Table B_7. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	3	7,200
Producing organic wastes	0	Undetermined
Producing inorganic wastes	0	Not applicable
Producing wastes of undetermined type	0	—
Totals	3	—

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_7. Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	2	2	1,663
Secondary	3	3	28,149
No treatment	11**	--	31,597

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes 8 communities having no comprehensive public sewerage system. Estimated combined population of these 8 communities is 10,346.

Table D_7. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	3	0	3	0
Total....	3	0	3	0

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_7. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	5	4	1	0	4	1	0
Industrial	0	0	0	0	0	0	0

Table F_7. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	0	—	0	—
1949	0	—	0	—

Table G_7. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	11[1]	31,597[1]	3
Enlargement or additions to existing plant	0	0	0
Replace existing plant	0	0	0
No project required	5[2]	29,812	0
Undetermined	0	0	0

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Includes 8 communities having no comprehensive public sewerage system. Estimated combined population of these 8 communities is 10,346.

[2] Includes one plant of inadequate design, but for which improved operations only are contemplated.

Table H_7. Status of treatment works project to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	7	3
Abatement ordered	0	0
Plans under preparation	0	0
Final plans approved	3	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	1	0

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I₇. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served **	Project requirements	Remarks
Ohio:			
Logan	6,177	New plant	—
Heine Packing Company	1,600	New plant	—
Nelsonville	5,368	New plant	—
Athens	9,706	New plant	—
The Stedman Company	4,200	New plant	Packing plant
Coolville	463	New plant	(1)
Bremen	1,176	New plant	(1)
Pickerington Creamery	1,400	New plant	—
Somerset	1,352	New plant	(1)
Shawnee	1,475	New plant	(1)
New Straitsville	1,473	New plant	(1)
Murry City	1,009	New plant	(1)
Glouster	2,847	New plant	(1)
Albany	551	New plant	(1)

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*The needs as set forth is this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Industrial organic waste load is expressed in population equivalent as measured by B.O.D.

[1] These communities have no comprehensive public sewerage system.

KANAWHA RIVER SUB-BASIN

General Description

The New River and the Gauley River join above Charleston, W. Va., to form the Kanawha River. From this point the Kanawha River flows in a northwesterly direction to its confluence with the Ohio River at Pt. Pleasant, W. Va. The New River has its headwaters in northern North Carolina, flows through the western corner of Virginia, then across West Virginia to its confluence with the Gauley River. The Gauley River lies entirely in the State of West Virginia. The Elk and Coal Rivers are the major tributaries of the Kanawha and also lie entirely in West Virginia. The sub-basin is mountainous in character, having rounded hills and wide valleys in the lower part and high mountains and deep gorges and ravines in the headwater areas. The area of the sub-basin is 12,300 square miles, of which 770 square miles are in North Carolina, 3,080 in Virginia, and 8,450 in West Virginia.

Economic Development

The natural resources in the sub-basin include coal, timber, natural gas, petroleum, salt, clays, sandstone, limestone, and ores of iron, lead, copper, and zinc. Excellent opportunities exist for development of hydroelectric power. Industrial activities in the sub-basin include coal production, chemical plant operation, agriculture, petroleum processing, lumber production, miscellaneous mining and quarrying and other related activities.

Rainfall and Runoff

The average annual precipitation is about 42 inches, varying from a low annual average of about 25 inches to a high annual average of about 50 inches. The U. S. Geological Survey currently reports stream flow data from more than 40 established gaging stations on the main stem and tributaries. Variations in flow during the day in the lower river due to regulated discharges from power installations at navigation dams are extreme and present a problem in connection with pollution abatement. For example, flows at Pt. Pleasant during normal flow conditions show a variation during the day from 16,000 cubic feet per second to zero flow. Comparable fluctuations occur at Winfield and Marmet.

Major River Developments

Three locks and dams on the Kanawha River and the pool from the Gallipolis Dam on the Ohio River provide for navigation of the main stem from its mouth to mile 90.57. Two multiple-purpose reservoirs, Bluestone on the New River and Sutton on the Elk River, are under construction by the Corps of Engineers. Five other reservoirs are authorized in the comprehensive plan of the Corps of Engineers. Many favorable locations exist for further development of headwater impoundments and run-of-river reservoirs for flood control, power development, and low-flow regulation. Several small developments have been made by private interests for power and water supply. Valuable potential benefits for water supply and pollution abatement exist in connection with comprehensive development of the water resources.

Population

The 1940 population of the sub-basin was about 834,800. Of this total, the 1940 population in municipalities now listed by the State water pollution control agencies as contributing pollution to the streams was approximately 400,000.

Water Uses

Surface waters are used for domestic, industrial, and livestock water supplies, waste disposal, navigation, production of hydroelectric power, and recreation. Seventy-six water supplies, serving 113 municipalities and an estimated population of about 270,000 persons, obtain water from surface sources. It has been estimated that domestic use from these supplies is about 21,000,000 gallons per day and that industry pumps more than one billion gallons of water from surface streams each day. As stated previously, the main stem has been developed for navigation for its entire length. In view of the possibilities for hydroelectric power development, this phase of the potential water resource is comparatively undeveloped. The headwater streams are used extensively for recreational purposes, including fishing, boating and swimming. There is much summer camping along the streams.

Sources of Pollution

Wastes from sewerage systems of 121 municipalities, 118 of which have a sewered population estimated at about 247,500 persons, are discharged into the streams of the sub-basin. Wastes from 211 other communities which have no comprehensive public sewerage systems, are discharged to the streams. Of these 211 communities, 204 have an estimated combined population of about 114,400. Population data for the remaining 7 have not been obtained. The pollution load discharged to the streams from 106 municipalities having public sewerage systems is estimated at about 193,000 population equivalent. The pollution load discharged from the remaining 226 municipal sources has not been determined. Wastes from 116 industrial plants not connected to municipal sewerage systems are discharged to the streams. Eleven plants producing organic wastes and 10 plants producing both organic and inorganic wastes discharge an estimated pollution load of 1,565,000 in terms of population equivalent. Sixteen industries contribute an undetermined organic pollution load. Inorganic wastes from 84 industries, including the 10 mentioned above, are discharged to the streams. Six industries produce wastes of undetermined type. The above sources of pollution include coal washing wastes but do not include consideration of acid mine drainage. The Ohio River Survey Report, representing conditions 10 years ago, estimated the total acid load from mine drainage to be about 33,000 tons per year before sealing. It was estimated that sealing of abandoned mines reduced the load discharged to the streams to about 19,000 tons per year. It is believed that the present acid load exceeds that estimated in the Survey Report. The acid mine drainage problem in the Kanawha Sub-Basin is of minor importance at the present time. The potential problems should not be forgotten, however, in view of the remaining large deposits of coal in the sub-basin.

Effects of Pollution on Water Uses

The West Virginia Water Commission issued the Kanawha River Basin Zoning Report in 1947, which indicates the effects of pollution on the streams of the Kanawha which lie within West Virginia. Inasmuch as the larger part of the area and more than 80 percent of the pollution load is in West Virginia, this report presents a fairly complete picture of stream conditions. In the report, Class "AA" streams are excellent sources of water supply and excellent for fish habitat and water supply. Class "A" streams are good for water supply, fish habitat, and recreation. Class "B" streams serve as a source of water supply with complete and auxiliary treatment, and are poor for fish habitat and recreational uses. Class "C" streams are not satisfactory as a source of water supply and are unsuitable for fish and recreational purposes. The report classifies the main stem from Belle (above Charleston) to its mouth as a class "C" stream, the condition of the stream being due to industrial and municipal waste discharge. The larger part of the Coal River is either class "B" or class "C". Practically all of the Elk River, except the headwater tributaries, is class "B" or class "C." Except for short reaches of pollution, the New River and the Gauley River are considered class "A" or class "AA" streams. It is apparent that pollution seriously affects legitimate water uses in the sub-basin.

Treatment Provided

Twenty-two municipalities with a population served of 33,000 have primary sewage treatment and 12 with a population served of 44,800 have secondary treatment. These 34 communities are served by 30 treatment plants of which, on the basis of original design, 20 are satisfactory, 6 are unsatisfactory, and the adequacy of 4 is undetermined. Eighteen industries have some treatment of wastes but only 7 of these are known to be satisfactory. It is estimated that less than 5 percent of the total organic waste load now discharged to the streams is receiving effective treatment. Treatment of inorganic wastes is also negligible.

Treatment Plants Required

Table G_8 contains summary data relative to treatment plant requirements in the sub-basin. Table I_8 lists individual municipal and industrial projects. The municipal treatment requirements include 86 new plants, 7 enlargements or additions to existing plants, and 3 replacements of existing plants. No projects are required at 22 locations, while requirements at 214 locations have not been determined. Most of the latter locations are small population centers which have no comprehensive public sewerage systems. Industrial treatment requirements include 28 new plants and 8 enlargements or additions to existing facilities. No new treatment facilities are required at 10 industrial plants, while the requirements at 70 locations have not been determined.

Tabular Data

Tables A_8 through I_8 contain data relative to pollution of the streams in the sub-basin. Data for Point Pleasant, located at the mouth of the Kanawha, are not included with data for this section, but are tabulated with data for the Ohio River Main Stem Sub-Basin.

Table A$_8$. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	106	233,895	193,010
Having population data available (Data on pollution load to watercourse incomplete or not available)	226[1] [2]	127,965[1]	Not applicable
Total	332[1] [2]	361,860[1]	—

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes data for 204 communities having no comprehensive public sewerage system, but which have been listed by State water pollution control agencies as contributing pollution to the streams. These 204 communities have an estimate combined population of 114,404.

[2] Includes 10 communities contributing pollution but for which no population data are available. Seven of these 10 have no comprehensive public sewerage systems.

Table B$_8$. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	21**	1,564,889
Producing organic wastes	16[1]	Undetermined
Producing inorganic wastes	84	Not applicable
Producing wastes of undetermined type	6	Undetermined
Total	116[2]	—

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 10 plants also producing inorganic wastes.

[1] Includes 1 plant also producing inorganic wastes.

[2] Total adjusted to correct for duplication noted in footnote marked thus, ** and thus [1].

Table C$_8$.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	22[1] [2]	19	33,065[1]
Secondary	12	11	44,816
No treatment	298[3] [4]	—	283,979[3]

*Includes incorporated or unincorporated municipalities; other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

[1] Includes data for 2 communities having no comprehensive public sewerage system but having a combined population of 2,795.

[2] Includes one community for which population data have not been determined.

[3] Includes data for 202 communities having no comprehensive public sewerage system, but which are listed by State water pollution control agencies as contributing pollution to the streams. These 202 communities have an estimated combined population of 111,609.

[4] Includes 9 communities, 2 with public sewerage systems and 7 without for which population data have not been determined.

Table D_8. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	11	2	5	4
Textile mill products......	4	2	1	1
Lumber and wood products...	1	0	0	1
Chemical and allied products....................	20	2	4	14
Products of petroleum and coal....................	5	1	1	3
Leather and leather products....................	3	3	0	0
Fabricated metal products..	1	0	0	1
Coal washing...............	54	0	2	52
Zinc mining................	1	1	0	0
Miscellaneous..............	10	6	1	3
Undetermined...............	6	1	2	3
Totals.....................	116	18	16	82

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_8. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	30*	20**	6	4	19	5	6
Industrial	18	7	0	11	7	0	11

*30 treatment plants serving 34 municipalities.
**1 of these plants serves 4 municipalities.

Table F_8. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	2	Undetermined
1947	0	—	2	Undetermined
1948	0	—	2	Undetermined
1949	0	—	3	Undetermined

Table G_8. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**[1]	Population served by facilities	Number**[1]
New plant	86[2] [3]	177,236	28
Enlargement or additions to existing plant	7[4]	16,205[4]	8
Replace existing plant	3	2,090	0
No project required	22[5] [6]	53,968[5]	10
Undetermined	214[7] [8]	112,361[7]	70

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by other tables. See discussion under "Pollution Prevention Measures Required", Part I of the report.

[2] Includes one community for which population data have not been determined.

[3] Includes data for one community with no comprehensive public sewerage system. This community has an estimated population of 1936.

[4] Includes data for two communities with no comprehensive public sewerage systems. These communities have an estimated combined population of 2795.

[5] Includes data for 2 communities having no comprehensive public sewerage system. These 2 communities have a combined estimated population of 677.

[6] Includes one community for which population data have not been determined.

[7] Includes data for 199 communities having no comprehensive public sewerage systems. These 199 communities have an estimated combined population of 108,996.

[8] Includes 8 communities for which population data have not been determined. Seven of these communities have no comprehensive public sewerage system.

Table H_8. Status of treatment works project to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	45	24
Abatement ordered	2	0
Plans under preparation	15	13
Final plans approved	3	0
Construction awaiting financing	0	0
Under construction	1	0
Status undetermined	244	69

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_8. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Virginia:			
Fries	1,800	New plant	Plans under preparation (Preliminary)
Washington Mills Co.	—	Undetermined	Plans under preparation
National Carbide Corp.	300	New plant	Plans under preparation
Radford	7,000	New plant	Plans under preparation (Preliminary)
Norfolk & Western Ry Co.	—	New plant	—
Superior Anthracite Mines Inc.	—	Undetermined	—
Pembroke Limestone Corp.	—	Undetermined	Clay wastes
Virginia Limestone Corp.	—	Undetermined	Clay wastes
Pearisburg	420	New plant	Preliminary report in preparation
Leas & McVitty	—	Undetermined	—
Celanese Corp. of America	200,000	Undetermined	Domestic sewage treatment satisfactory
Narrows	800	New plant	Final plans under preparation
Rich Creek	400	New plant	—
Fields Manufacturing Co.	—	Undetermined	Wool scouring wastes
Galax	2,400	New plant	—
Wytheville	2,500	New plant	Plans under preparation
Wytheville Packing Co.	—	New plant	Abattoir wastes
Silica Products Co.	—	Undetermined	Has settling basin
Crockett	150	Undetermined	(1)
National Fruit Products	—	Undetermined	—
Hillsville	1,000	Undetermined	Plans under preparation
American Pigment Corp. (Hiwassee)	—	Undetermined	Ore washing wastes
Pulaski	9,000	New plant	—
American Pigment Corp. (Pulaski)	—	Undetermined	—
General Chemical Div., Allied Chemical & Dye Corp	—	New plant	Acid and cinder dust wastes-Plans under preparation
Pulaski Laundry & Dry Cleaners	—	New plant	20,000 gallons per day laundry waste
Pulaski Mirror Co.	—	Undetermined	Soda ash and metallic copper wastes
W. C. Simpson & Son	—	Undetermined	—
Huff Canneries	—	Undetermined	—
Meadowview Co-op. Cannery Inc.	—	Undetermined	—
W. R. Meyers & Co.	—	Undetermined	Abattoir wastes
Cambria	200	Undetermined	—
Pocahontas Fuel Co. Inc.	60	Undetermined	—
Pocahontas	1,600	Undetermined	—
Bland Correctional Farm	600 (proposed population)	New plant	Final plans being prepared
West Virginia:			
Glen Ferris	600	New plant	—
Charleston Hts.	100	New plant	—
Falls View	300	New plant	—
Deepwater	738	Undetermined	(1)

See footnotes at end of table.

Table I$_8$. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served **	Project requirements	Remarks
West Virginia--Continued			
Alloy	500	New plant	—
Boomer	700	New plant	—
Eagle	531	Undetermined	([1])
Longacre	100	New plant	—
Semet-Solvay Co.	—	Undetermined	Coal washing
Smithers[2]	2,230	New plant	—
Montgomery[2]	3,200	New plant	—
Handley	200	New plant	—
London	688	Undetermined	([1])
Hugheston	900	Undetermined	([1])
Pratt[2]	330	New plant	—
Hudnall	505	Undetermined	([1])
Hansford	350	Undetermined	([1])
Crown Hill	745	Undetermined	([1])
Glasgow[2]	300	New plant	—
Cedar Grove[2]	1,100	New plant	—
East Bank[2]	800	New plant	—
Coalburg	290	Undetermined	([1])
Cabin Creek	100	New plant	—
Appalachian Electric Power Co.	—	Additions	—
Chelyan	150	New plant	—
Hope Gas Co.	—	New plant	—
Dickenson	508	Undetermined	([1])
Diamond	600	Undetermined	([1])
Chesapeake[2]	200	New plant	—
Snow Hill	770	Undetermined	([1])
Belle	1,400	New plant	—
Belle Alkali Co.	2,665	New plant	Chemical plant
E.I. DuPont Co. (Belle)	695,388	New plant	Chemical plant (Plans under preparation)
Marmet[2]	1,000	New plant	—
Connell	140	New plant	—
Levi	450	New plant	—
Malden	350	New plant	—
South Malden	50	Undetermined	—
Reed	250	New plant	—
E. Kanawha Estates	500	New plant	—
Charleston[2]	68,000	New plant	Abatement ordered
Owens-Illinois Co.	3,026	New plant	—
Libby-Owens-Ford Co.	977	Undetermined	—
Evans Lead Co.	965	New plant	—
South Charleston[2]	9,000	New plant	Plans under preparation
American Folk & Hoe Co.	3,000	New plant	Metal forging
Carbide & Carbon Chemical Corp. (S. Charleston)	500,000	New plant	Chemical plant-- Plans under preparation
Barium Reductions, Inc.	11,795	New plant	—
Westvaco, Inc.	2,402	New plant	Plans under preparation
Dunbar[2]	5,200	New plant	Plans under preparation
Fletcher Enamel Co.	345	New plant	—
Dunbar Glass Co.	136	New plant	—
Institute	900	New plant	—
W. Va. State College	—	New plant	—
Carbide & Carbon Chemical Corp. (Institute)	90,000	New plant	Plans under preparation

See footnotes at end of table.

Table I_g. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Synthetic Rubber Plant	—	Undetermined	Held in standby condition as of July 1950
St. Albans[2]	6,000	New plant	Plans under preparation
Nitro[2]	4,000	New plant	Abatement ordered
American Viscose Corp.	--	New plant	Chemical plant - Plans under preparation
Ohio-Apex Corp.	35,000	New plant	Chemical plant - Plans under preparation
Monsanto Chemical Co.	13,100	New plant	Chemical plant - Plans under preparation. Pilot treatment plant in operation
Poca	350	New plant	—
Black Betsy	550	Undetermined	(1)
Plymouth	300	Undetermined	(1)
Winfield[2]	100	New plant	—
Redhouse	200	Undetermined	(1)
Eleanor	700	New plant	—
Buffalo[2]	200	New plant	—
Henderson[2]	398	Undetermined	(1)
Point Pleasant[2]	(See main stem - Ohio River)		(3)
Mary Frances Coal Co.	—	Undetermined	Coal washing
Ingram Branch	540	Undetermined	(1)
Kincaid	621	Undetermined	(1)
Page	927	Undetermined	(1)
Robson	501	Undetermined	(1)
Eastern Gas & Fuel Association (Robson)	—	Undetermined	Coal washing
Beards Fork	953	Undetermined	(1)
Eastern Gas & Fuel (Beards Fork)	—	Undetermined	Coal washing
Elk Ridge	742	Undetermined	(1)
Powellton	300	New plant	—
Kimberly	150	New plant	—
Marting	506	Undetermined	(1)
Cannelton	90	New plant	—
Carbondale	785	Undetermined	(1)
Domwood	300	Undetermined	(1)
Long Branch	300	Undetermined	(1)
Pax[2]	631	Undetermined	(1)
Mossy	527	Undetermined	(1)
Kingston	1,345	Undetermined	(1)
Milburn	550	New plant	—
Mahan	669	Undetermined	(1)
Burnwell	919	Undetermined	(1)
Gallagher	638	Undetermined	(1)
Mammoth	882	Undetermined	(1)
Warner Collieries Co.	—	Undetermined	Coal washing
Ward	2,200	Undetermined	(1)
Republic	518	Undetermined	(1)
Carbon	125	New plant	—
Carbon Fuel Co.	--	Undetermined	Coal washing
Decota	100	Undetermined	—
Laing	545	Undetermined	(1)
Eskdale	1,146	Undetermined	(1)
Ohley	286	Undetermined	(1)
Dawes	250	Undetermined	(1)

See footnotes at end of table.

Table I_8. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Sharon	741	Undetermined	(1)
Dry Branch	950	Undetermined	(1)
Pure Oil Co.	--	Additions	Plans under preparation
Notomine	600	Undetermined	(1)
United	1,200	Undetermined	(1)
Wevaco	400	Undetermined	(1)
Highcoal	602	Undetermined	(1)
Kayford	1,584	Undetermined	(1)
Truax-Traer Coal Co.	--	Additions	Coal washing; plans under preparation
Acme	667	Undetermined	(1)
Leewood	250	Undetermined	(1)
Winifrede	800	Undetermined	(1)
Hernshaw	85	Undetermined	(1)
Putney	803	Undetermined	(1)
Rensford	629	Undetermined	(1)
Hatfield-Campbell Creek Coal Co.	--	Undetermined	Coal washing
Tad	546	Undetermined	(1)
Coal Fork	843	Undetermined	(1)
Bergoo	400	New plant	--
Webster Springs[2]	1,000	New plant	--
Centralia	300	Undetermined	(1)
Sutton[2]	450	New plant	--
Gassaway[2]	1,430	New plant	--
Otter	1,936	New plant	(1)
Clay[2]	300	Undetermined	--
Hope Natural Gas Co.	--	Undetermined	Insoluble volatile hydrocarbon wastes
Clendenin[2]	1,100	New plant	--
United Fuel Gas Co.	--	Undetermined	Insoluble volatile hydrocarbon wastes
Elk Refining Co.	--	Additions	Oil and caustic wastes-Plans under preparation
Widen	1,598	Undetermined	(1)
Elk River Coal & Lumber Co.	--	New plant	Coal washing
Swandale	300	Undetermined	(1)
Dundon	125	New plant	--
Newton	400	Undetermined	(1)
Bloomington	--	Undetermined	(1)
Amma	75	Undetermined	(1)
Wellford	150	Undetermined	(1)
Middle Fork	75	Undetermined	(1)
Morris	--	Undetermined	(1)
Roderic	--	Undetermined	(1)
Quick	103	Undetermined	(1)
Coco	150	Undetermined	(1)
Blue Creek	310	Undetermined	(1)
Guthrie	18	Undetermined	(1)
L.M. McCown & Son	--	Additions	Abattoir wastes
Fischer & Fischer	--	Additions	Abattoir wastes
P.E. Holz & Son	--	Additions	Abattoir wastes
Whitesville[2]	800	New plant	--
Seth	1,253	Undetermined	(1)
Comfort	506	Undetermined	(1)
Racine	539	Undetermined	(1)
Rumble	799	Undetermined	(1)
Ashford	300	Undetermined	(1)

See footnotes at end of table.

Table I_8. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Glogora Coal Co..............	—	Undetermined	Coal washing
Red Dragon..................	400	Undetermined	(1)
Prenter.....................	600	Undetermined	(1)
Red Parrot Coal Co..........	—	New plant	Coal washing
Brush Creek (Ridgeview).....	765	Undetermined	(1)
American Rolling Mill Co....	—	Undetermined	Coal washing
Olcott......................	655	Undetermined	(1)
Lico........................	545	Undetermined	(1)
Madison[2]..................	1,180	New plant	—
Westmoreland Coal Co........	—	Undetermined	Coal washing
Danville[2].................	300	New plant	—
Julian......................	250	Undetermined	(1)
Blair.......................	215	Undetermined	(1)
Monclo......................	597	Undetermined	(1)
Boone Co. Coal Corp.........	—	Undetermined	Coal washing
Clothier....................	1,000	Undetermined	(1)
Hewett......................	669	Undetermined	(1)
Ottawa......................	400	Undetermined	(1)
Jeffery.....................	600	Undetermined	(1)
Secoal......................	100	Undetermined	(1)
Greenview...................	300	Undetermined	(1)
Rock Lick...................	25	Undetermined	(1)
Barrett.....................	400	Undetermined	(1)
Wharton.....................	800	Replacement	—
Van.........................	275	Undetermined	(1)
Y & O Coal Co...............	—	New plant	Coal washing
Dorothy Gordon Coal Co......	—	New plant	Coal washing
Gordon......................	400	Undetermined	(1)
Cameo (Silush)..............	350	Undetermined	(1)
Cameo Coal Mining Co........	—	Undetermined	Coal washing
Eccles......................	2,186	Undetermined	(1)
Eastern Gas & Fuel Association..................	—	Undetermined	Coal washing
Edwight.....................	1,294	Undetermined	(1)
Raleigh-Wyoming Mining Co...	—	New plant	Coal washing
Montcoal....................	900	Undetermined	(1)
American Rolling Mill Co....	—	Undetermined	Coal washing
Lillybrook Coal Co..........	—	Undetermined	Coal washing
Glen White..................	1,026	Undetermined	(1)
Lester[2]...................	909	Undetermined	(1)
Marfork.....................	250	Undetermined	(1)
Clear Creek.................	798	Undetermined	(1)
Artie.......................	685	Undetermined	(1)
Ameagle.....................	200	New plant	(1)
Colcord.....................	648	Undetermined	(1)
Dorothy.....................	100	New plant	—
Leevale.....................	300	Undetermined	(1)
Walton......................	300	Undetermined	(1)
Sissonville.................	140	Undetermined	(1)
Hurricane[2]................	900	Additions	—
Camden-on-Gauley[2].........	300	New plant	—
Swiss.......................	350	Undetermined	(1)
Jodie.......................	535	Undetermined	(1)
Gamoca......................	275	Undetermined	(1)
Gauley Bridge...............	700	New plant	—
Cowen.......................	500	New plant	—

See footnotes at end of table.

Table I₈. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served **	Project requirements	Remarks
West Virginia--Continued			
Richwood[2]	4,200	New plant	—
Cherry River Boom & Lumber Co.	—	New plant	—
Wallace Corp.	—	New plant	—
Fenwick	530	Undetermined	(1)
Holcomb	150	Undetermined	(1)
Mt. Hope Coal Co.	—	Undetermined	Coal washing
Nettie	214	Undetermined	(1)
Johnstown Coal & Coke Co.	—	Undetermined	Coal washing
Marybell	—	Undetermined	(1)
Panther Coal Co.	—	Undetermined	Coal washing
Summersville[2]	540	Replacement	New plant under construction
Delmont Fuel Co.	—	Undetermined	Coal washing
Peters Creek Coal Co.	—	Undetermined	Coal washing
Hookersville	300	Undetermined	(1)
Raven Coals, Inc.	—	Undetermined	Coal washing
Rupert[2]	902	Undetermined	Final plans approved
Charmco	75	Undetermined	(1)
Nallen	450	Undetermined	(1)
Clearco	200	Undetermined	(1)
Duo	130	Undetermined	(1)
Anjean	644	Undetermined	(1)
Leckie Smokeless Coal Co.	—	Undetermined	Coal washing
Kessler	—	Undetermined	(1)
Springdale	554	Undetermined	(1)
Bellwood	300	Undetermined	(1)
Rainelle[2]	1,100	New plant	—
East Rainelle[2]	1,300	New plant	—
Marfrance	875	Undetermined	(1)
Quinwood[2]	1,375	Undetermined	(1)
Imperial Smokeless Coal Co.	—	Undetermined	Coal washing
Crichton	300	Undetermined	(1)
Leslie	774	Undetermined	(1)
Bellburn	633	Undetermined	(1)
McClung	—	Undetermined	(1)
Hinton[2]	5,250	New plant	—
Meadow Creek	500	Undetermined	(1)
Quinnimont	475	Undetermined	(1)
Terry	300	Undetermined	(1)
Maryland Fire Cr. Coal Co.	—	Undetermined	Coal washing
McKendree	80	Undetermined	(1)
State Emergency Hospital	100	New plant	—
Thayer	450	Undetermined	(1)
Claremont	60	Undetermined	(1)
Thurmond[2]	250	New plant	—
Rush Run	200	Undetermined	(1)
Brooklyn	300	Undetermined	(1)
Scotia Coal & Coke Co.	—	Undetermined	Coal washing
Sewell	250	Undetermined	(1)
Cunard	536	Undetermined	(1)
Gatewood	744	Undetermined	(1)
Garten	662	Undetermined	(1)
Elverton	260	Undetermined	(1)
South Nuttall	250	Undetermined	(1)
Nuttalburg	300	Undetermined	(1)
Kaymoor	300	Undetermined	(1)

See footnotes at end of table.

Table I$_g$. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
New R. & Pocahontas Consolidate Fuel Co.	—	Undetermined	Coal washing
Fayette	40	Undetermined	(1)
Ames Mining Co.	—	Undetermined	Coal washing
Lansing	500	Undetermined	(1)
Peterstown[2]	250	New plant	—
Oakvale[2]	273	Undetermined	(1)
Union[2]	345	New plant	—
Greenville	346	Undetermined	(1)
Nemours	150	Undetermined	(1)
Bramwell[2]	800	New plant	—
Montcalm	872	Undetermined	(1)
Rock	700	Undetermined	(1)
Spanishburg	400	Undetermined	(1)
Goodwill	616	Undetermined	(1)
Winding Gulf Collieries	—	Undetermined	Coal washing
McComas	195	New plant	—
Pocahontas Fuel Co.	—	Undetermined	Coal washing
American Coal Co.	—	Undetermined	Coal washing
Giatto	250	Undetermined	(1)
Matoaka[2]	926	Undetermined	(1)
Lamar	516	Undetermined	(1)
Lamar Colliery Co.	—	Undetermined	Coal washing
Algonquin	516	Undetermined	(1)
Dott (Wenonah)	654	Undetermined	(1)
Turkey Gap Coal & Coke Co.	—	Undetermined	Coal washing
Arista	586	Undetermined	(1)
Weyanoke Coal & Coke Co.	—	Undetermined	Coal washing
Springton	500	Undetermined	(1)
Hiawatha	118	Undetermined	(1)
Widemouth	602	Undetermined	(1)
American Coal Co.	—	Undetermined	Coal washing
Princeton	6,500	New plant	Plans under preparation
Athens (with Concord State Teachers College[2]	1,210	Additions	Final plans approved
Cass[2]	350	New plant	—
Marlington[2]	1,600	New plant	—
International Shoe Co.	—	Additions	Tanning wastes
Falling Spring[2]	388	Undetermined	(1)
Denmar (with State Tuberculosis Sanatorium)	295	Additions	(1)
Caldwell	250	Undetermined	(1)
Lewisburg[2]	1,000	New plant	—
Ronceverte[2]	2,265	New plant	Final plans approved
Snowflake	115	Undetermined	(1)
Acme Limestone Co.	—	Undetermined	—
Alderson[2]	1,500	New plant	—
Federal Women's Prison	750	Replacement	—
Pence Springs	60	Undetermined	(1)
Huntersville	65	Undetermined	(1)
Howes Leather Co.	—	New plant	Tanning wastes
Durbin[2]	475	New plant	—
Meadow Bridge[2]	477	Undetermined	(1)
Layland	960	Undetermined	(1)
Kathryn	25	Undetermined	(1)
Laurel Cr. Smokeless Coal Co.	—	Undetermined	Coal washing

See footnotes at end of table.

Table I_g. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Lawton (Brownwood).........	115	Undetermined	—
Laurel Creek...............	550	Undetermined	(1)
Laurel Creek Coal Co......	—	Undetermined	Coal washing
Ghent......................	589	Undetermined	(1)
Fireco.....................	400	New plant	—
E. W. Meadows Coal Co.....	—	Undetermined	Coal washing
Coal City..................	868	Undetermined	(1)
Whitby.....................	643	Undetermined	(1)
Sterling Smokeless Coal Co.	—	Undetermined	Coal washing
Sullivan...................	732	Undetermined	(1)
Lillybrook Coal Co. (Sullivan)...............	—	Undetermined	Coal washing
Pemberton..................	811	Undetermined	(1)
Crab Orchard...............	533	Undetermined	(1)
Gulf Mining Co.............	—	Undetermined	Coal washing
Raleigh....................	2,500	(Connected to Beckley plant)	[1](See Beckley)
Beckley[2]..................	9,100	Enlargement	Loans requested for plan preparation
Raleigh Coal & Coke Co....	—	Undetermined	—
East Beckley...............	1,500	(Connected to Beckley plant)	(See Beckley)
Shady Spring...............	519	Undetermined	(1)
Sprague....................	1,256	Undetermined	(1)
Stanaford..................	50	New plant	—
New River Co. (Stanaford).	—	Undetermined	Coal washing
Lanark.....................	600	Undetermined	(1)
Affinity...................	450	Undetermined	(1)
Lillybrook Coal Co. (Affinity)...............	--	Undetermined	Coal washing
Blue Jay...................	250	Undetermined	(1)
Beaver.....................	500	Undetermined	(1)
Glen Hendrick..............	250	New plant	—
Mabscott[2].................	700	(Connected to Beckley plant)	—
Prosperity.................	669	Undetermined	(1)
Cranberry..................	716	Undetermined	(1)
Skelton....................	500	Undetermined	(1)
Tamroy.....................	425	Undetermined	(1)
Oswald.....................	320	Undetermined	(1)
Price Hill.................	608	Undetermined	(1)
Kilsyth....................	637	Undetermined	(1)
Calloway...................	—	Undetermined	(1)
Mt. Hope[2].................	2,100	New plant	—
New River Co. (Mt. Hope)..	—	Undetermined	Coal washing
McDonald...................	350	Undetermined	(1)
Dunloup....................	200	Undetermined	(1)
Sun........................	827	Undetermined	(1)
Glen Jean..................	639	Undetermined	(1)
Red Star...................	500	Undetermined	(1)
Hilltop....................	614	Undetermined	(1)
Harvey.....................	350	Undetermined	(1)
Prudence...................	250	Undetermined	(1)
Carlisle...................	693	Undetermined	(1)
New River Co. (Carlisle)..	—	Undetermined	Coal washing
Whipple....................	805	Undetermined	(1)
Scarbro....................	602	Undetermined	(1)

See footnotes at end of table.

Table I_8. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Minden	1,858	Undetermined	(1)
New R. & Pocahontas Coal Co.	—	Undetermined	Coal washing
Concho	250	Undetermined	(1)
Lookout	638	Undetermined	(1)
Winona	1,058	Undetermined	(1)
Summerlee	747	Undetermined	(1)
New River Co. (Summerlee)	—	Undetermined	Coal washing
Lochgelly	671	Undetermined	(1)
New River Co. (Lochgelly)	—	Undetermined	Coal washing
Fayetteville[2]	700	New plant	Plans under preparation
Ansted[2]	150	New plant	—

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B.O.D. Generally the figure for those municipalities with no comprehensive public sewerage system is the estimated total population.

[1] No community sewerage system.

[2] Incorporated municipalities in West Virginia.

[3] Point Pleasant, W. Va., discharges to both the Ohio and Kanawha Rivers. Tabular data for this community are included with data for the Ohio Main Stem Sub-Basin, and are excluded from the data for the Kanawha River.

GUYANDOT RIVER SUB-BASIN

General Description

The Guyandot River is formed by the junction of Winding Gulf and Stonecoal Creeks in southwestern West Virginia and flows in a general northerly direction to Huntington, where it discharges into the Ohio River. The drainage basin, located entirely within the State of West Virginia, is about 18 miles wide and 95 miles long, with a total area of 1,671 square miles. The area is mountainous and is characterized by steep slopes and narrow, winding valleys. The major tributary to the Guyandot River is the Mud River which drains an area of 358 square miles. This tributary discharges to the Guyandot about 7 miles above the mouth.

Approximately 85 percent of the area is underlain with coal seams containing, on an estimate by the West Virginia Geological Survey made prior to 1932, about 15,900,000 tons of minable coal.

Economic Development

Coal mining is by far the most important industry in the sub-basin. A great majority of the people are either directly or indirectly dependent upon the mining industry for a livelihood. The rugged terrain of the sub-basin makes it unsuitable for extensive agricultural development. Small-scale farming, however, is practical and occupies a portion of the population. This farming is primarily of the subsistence type and contributes little to outside markets. In addition to the extensive coal deposits, the resources include an abundant supply of natural gas. Lumbering operations, formerly of major importance in the area, have been sharply curtailed by the depletion of virgin timber.

Rainfall and Runoff

The average annual precipitation is about 44 inches. This precipitation is distributed fairly uniformly over the entire sub-basin. The annual average over the headwater area is about 42 inches, over the central portion about 46 inches, and over the lower portion about 43 inches. Three U. S. Geological Survey stream-gaging stations are located in the sub-basin. The station at Branchland, W. Va., on the main stream, recorded an average discharge of 1,424 cubic feet per second for an 18-year period (1929-47). The drainage area above this station is 1,226 square miles. The extreme minimum recorded daily flow was 3.6 cubic feet per second and occurred in October 1930. Another station on the main stream at Man, W. Va., has recorded an average discharge of 889 cubic feet per second for an 18-year period (1929-47). The drainage area above this station is 762 square miles. Average flow data for the third station, located on the Mud River near Milton, W. Va., are not available.

Major River Developments

No major river developments now exist in the Guyandot Sub-Basin. One flood control reservoir has been authorized for the Mud River, but construction has not been started. This development is a Department of the Army, Corps of Engineers, project. The pool of the reservoir will extend for several river miles upstream from a point some 6 stream miles above Milton.

Many years ago the State of Virginia developed the lower portion of the Guyandot for navigation by the construction of six small locks and dams. After a few years of use, these facilities fell into a state of disrepair and were destroyed by high water. Subsequently, from about 1880 until 1912, the Federal Government maintained a small project providing for the removal of obstructions from the channel and overhanging trees from the banks along the lower 120 miles of the river. No practical use is made of any of the remaining results of these improvements at the present time.

Population

The 1940 population of the sub-basin was 148,257. This figure does not include the population for the portion of Huntington, W. Va., which lies within the boundaries of the sub-basin. The population is predominantly rural. The only two towns classified as urban by the 1940 census were Logan (population 5,166) and Mullins (population 3,0[illegible]6). Much of the rural population is in mining camps, many of which are in the vicinity of Logan. One hundred and forty communities contribute significant amounts of domestic wastes to the streams of the sub-basin. The 1940 population of 133 of these communities was about 91,400. The 1940 population data for the remaining 7 communities have not been obtained.

Water Uses

Surface waters of the sub-basin are used as sources for public water supplies, coal washing, cooling water at power plants and gas compressor stations, railroad uses, waste disposal, and for recreational purposes. Surface waters are sources of all or part of the water for public water supplies serving some 23,000 people in 25 communities in the sub-basin. One hundred and forty communities in the area dispose of their domestic wastes by discharging them to the streams. Parts of the main stream and some of its tributaries are considered fairly good bass fishing streams and are used quite extensively by local residents for fishing and other recreation. There are no areas along the streams which have been specifically developed for recreational use. The river is not used for navigation except for light traffic near the mouth where it is affected by backwater from the Ohio River.

Sources of Pollution

The domestic wastes from a sewered population of about 73,000 in 140 communities are discharged to the streams of the sub-basin. These figures do not include data for Huntington, W. Va. Huntington is located on the Ohio River at the mouth of the Guyandot and discharges wastes into both rivers. All data for this city are included with data for the Ohio River. Only one industrial plant in the sub-basin has been reported as producing organic waste. The amount of this waste has not been determined. Forty-eight industrial plants produce inorganic wastes. Acid mine drainage contributes to the pollution of some tributaries, but has little effect on the main stream.

Effects of Pollution on Water Uses

The State Water Commission has classified the quality of the waters of the various streams. More than 50 percent of the main stream and many of the tributaries are classified as unsuitable as a source of water supply, fish habitat, or recreational water. This classification is primarily due to excessive coliform content, to color, and turbidity and sludge deposits from coal washing operations. Acid mine drainage is also a factor at some locations. Public health hazards are created by the discharge of untreated domestic wastes at points upstream from existing public water supply intakes. These wastes also limit development of potential water supplies and industrial expansion. Coal washeries discharge wastes containing coal fines and mineral matter to the streams of the sub-basin, resulting in objectionable color in the waters and black deposits along the stream beds. Sealing of many of the abandoned mines has considerably reduced the acid load discharged to the surface waters. Much of the present acid load comes from active mines. Acid conditions, however, still render some of the tributary streams unsuitable for aquatic life.

Treatment Provided

Very little treatment for domestic wastes is provided in the sub-basin. Only three communities have waste treatment facilities. These three provide primary treatment for the domestic wastes from a combined population of 1,140. Wastes from a combined population of about 72,000 in 137 communities receive no treatment before being discharged to the streams. Table D_9 indicates that information on the present treatment facilities at 48 of the industries in the sub-basin has not been obtained. Only one industrial plant in the sub-basin is known to provide treatment for its wastes. Tables C_9, D_9 and E_9 contain additional data relative to waste treatment in the sub-basin.

Treatment Plants Required

Table G_9 contains data relative to treatment plant requirements in the sub-basin. Table I_9 lists individual municipal and industrial requirements. Twenty-four municipalities require new plants to serve a combined population of about 18,000. Two treatment plants, now serving an estimated combined population of about 1,050, require replacement. The treatment plant requirements for 113 municipalities have not been determined. Nine industrial plants require new waste treatment facilities, and the requirements for 39 have not been determined.

Tabular Data

Tables A_9 through I_9 present data concerning stream pollution in the Guyandot Sub-Basin. Many minor sources of pollution exist for which data cannot be included. The practices of locating privies over and along small streams, and of dumping garbage and other refuse into the streams is common in the area.

Table A₉. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	24	17,065	17,065
Having population data available (Data on pollution load to watercourse incomplete or not available)	116[1][2][3]	55,892[1][3]	Not applicable
Total	140[1][2][3]	72,957[1][3]	—

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimate of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 106 communities having no comprehensive public sewerage systems, but for which population data are available. These 106 communities have an estimated combined population of 53,542.

[2] Includes 6 communities for which no population estimates are available. These communities have no comprehensive public sewerage systems.

[3] Does not include Huntington. Wastes are discharged into mouth of Guyandot and Ohio River and are included in Main Stem data.

Table B₉. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	0	—
Producing organic wastes	1	Undetermined
Producing inorganic wastes	48	Not applicable
Producing wastes of undetermined type	0	—
Total	49	—

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C₉.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	3	3	1,140
Secondary	0	0	0
No treatment	137**[1]	—	71,817**

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes 106 communities having no comprehensive public sewerage system, but for which population data are available. These 106 communities have an estimated combined population of 53,542.

[1] Includes 6 communities for which no population estimates are available. These communities have no comprehensive public sewerage system.

Table D_9. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	1	0	0	1
Coal washery...............	47	1	0	46
Primary metal industries...	1	0	0	1
Totals..................	49	1	0	48

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_9. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	3	1	2	0	1	2	0
Industrial	1	1	0	0	1	0	0

Table F_9. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	0	—	0	—
1949	0	—	0	—

Table G_9. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	24	17,975	9[1]
Enlargement or additions to existing plant	0	0	0
Replace existing plant	2	1,050	0
No project required	1	90	1
Undetermined	113[2] [3]	53,842[2]	39

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Includes some industrial plants which may or may not have some form of ineffective treatment at present.

[2] Includes 106 communities having no comprehensive public severage system, but for which population data are available. These 106 communities have an estimated combined population of 53,542.

[3] Includes 6 communities for which population data have not been determined, and which have no comprehensive public severage system.

Table H_9. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	4	8
Abatement ordered	0	0
Plans under preparation	2	4
Final plans approved	1	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	132	36

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I₉. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
West Virginia:			
Buckeye Coal & Coke Co......	—	Undetermined	Coal washery
Stephenson (Devils Fork)....	553	Undetermined	(1)
Iroquois.....................	210	Undetermined	(1)
Corinne......................	350	New plant	—
Elmore.......................	10	Undetermined	(1)
Tralee.......................	75	New plant	—
Semet-Solvay Div.	—	Undetermined	Coal washery
Itman........................	1,091	Undetermined	(1)
Pineville[2]	600	New plant	—
Marianna.....................	500	New plant	—
Marianna Smokeless Coal Company..........	—	Undetermined	Coal washery
Wyoming......................	125	New plant	—
Red Jacket Coal Corp.........	—	Undetermined	Coal washery
Baileysville.................	500	Undetermined	(1)
Justice......................	200	Undetermined	(1)
Gilbert[2]...................	490	Undetermined	(1)
Tamcliff.....................	260	Undetermined	(1)
Verner.......................	50	Undetermined	(1)
Wylo.........................	18	Undetermined	(1)
Christian....................	250	New plant	—
Landville....................	400	Undetermined	(1)
Man[2].......................	1,000	New plant	—
Taplin.......................	100	Undetermined	(1)
Earling......................	769	Undetermined	(1)
W. Va. Coal & Coke Corp......	—	Undetermined	Coal washery
Rita.........................	280	Undetermined	(1)
Snap Creek Coal Co...........	—	Undetermined	Coal washery. Plans under preparation.
Lyburn.......................	300	Undetermined	(1)
Kleenkool (Dabney)...........	300	Undetermined	(1)
McConnell....................	450	Undetermined	(1)
Stollings....................	704	Undetermined	(1)
Hutchinson Coal Co...........	—	Undetermined	Coal washery
Logan[2].....................	5,000	New plant	Final plans approved
West Logan...................	741	Undetermined	(1)
Aracoma......................	500	Undetermined	(1)
Peach Creek..................	450	New plant	—
James & Heatherman Coal Company..........	—	Undetermined	Coal washery
Hughey.......................	540	Undetermined	(1)
Henlawson....................	1,387	Undetermined	(1)
Chapmanville[2]..............	1,000	Undetermined	(1)
Big Creek....................	450	Undetermined	(1)
Branchland...................	518	Undetermined	(1)
West Hamlin[2]...............	950	Undetermined	(1)
Barboursville[2].............	1,350	New plant	Plans under preparation
Huntington[2]................	—	—	(1)
International Nickel Co......	—	New plant	Plans under preparation
East Gulf....................	710	Undetermined	(1)
C. H. Meade Coal Co..........	—	Undetermined	Coal washery
Rhodell[2]...................	995	Undetermined	(1)
Amigo Smokeless Coal Company	—	Undetermined	Coal washery
Princewick...................	995	Undetermined	(1)

See footnotes at end of table.

Table 19. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served **	Project requirements	Remarks
West Virginia—Continued			
Lillybrook	808	Undetermined	(1)
Lillybrook Coal Co. (Lillybrook)	—	New plant	Coal washery
Pickshin	250	Undetermined	(1)
Lego	541	Undetermined	(1)
Besoco	752	Undetermined	(1)
Gulf Smokeless Coal Co.	—	Undetermined	Coal washery
Vanwood	535	Undetermined	(1)
Killarney	814	Undetermined	(1)
Lillybrook Coal Co. (Killarney)	—	Undetermined	Coal washery
Odd	300	Undetermined	(1)
Tommy Creek	200	Undetermined	(1)
Epperly	300	Undetermined	(1)
Winding Gulf	650	Undetermined	(1)
Winding Gulf Collieries	—	New plant	Coal washery
Lynwinn	500	Undetermined	(1)
Hotcoal	300	Undetermined	—
Big Stick	250	Undetermined	(1)
McAlpin	858	Undetermined	(1)
Lillybrook Coal Co. (McAlpin)	—	Undetermined	Coal washery
McAlpin Coal Co.	—	Undetermined	Coal washery
Stotesbury	125	New plant	—
Eastern Gas & Fuel Association (Stotesbury)	—	New plant	Coal washery
Tams	150	New plant	—
Gulf Smokeless Coal Co. (Tams)	—	New plant	Coal washery
Ury	250	Undetermined	(1)
Helen	1,200	New plant	—
Eastern Gas & Fuel Association (Helen)	—	New plant	Coal washery
Malco	150	Undetermined	(1)
Wacomah	100	Undetermined	(1)
Amigo (Tommy Creek)	532	Undetermined	(1)
Wyco	526	Undetermined	(1)
Clinchfield Coal Corp.	—	Undetermined	Coal washery
Allen	12	Undetermined	(1)
Slab Fork	50	New plant	—
Slab Fork Coal Co.	—	Undetermined	Coal washery
Hotchkiss	50	Undetermined	(1)
Maben	100	New plant	—
West Gulf Coal Co.	—	Undetermined	Coal washery
Otsego	680	Undetermined	(1)
Brule Smokeless Coal Co.	—	Undetermined	Coal washery
Caloric	300	Undetermined	(1)
Muriva (Harmco)	400	Undetermined	(1)
Mullens[2]	2,800	New plant	Plans under preparation
Bud	737 combined	Undetermined	(1)
Alpoca		Undetermined	(1)
Covel	300	Undetermined	(1)
American Coal Co.	—	Undetermined	Coal washery
Herndon	600	Undetermined	(1)

See footnotes at end of table.

Table I9. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Lamar Colliery Co.	—	Undetermined	Coal washery
Micajah	111	Undetermined	(1)
Mulberry	—	Undetermined	(1)
Oceana[2]	100	Undetermined	(1)
Lynco	—	Undetermined	(1)
Crozer Land & Coal Co.	—	Undetermined	Coal washery
Clear Fork	500	Undetermined	(1)
Glen Rogers	300	New plant	—
Raleigh-Wyoming Mining Company	—	Undetermined	Coal washery
Glen Morrison	808	Undetermined	(1)
Tipple	542	Undetermined	(1)
Milam	100	Undetermined	(1)
Eastern Gas & Fuel Association (Kopperston)	—	New plant	Coal washery
Emmet	524	Undetermined	(1)
Elk Creek Coal Co.	—	Undetermined	Coal washery
Swope	—	Undetermined	(1)
Cyclone	66	Undetermined	(1)
Campus	—	Undetermined	(1)
Davin	100	Undetermined	(1)
Mallory	200	New plant	—
Powellton Coal Co.	—	Undetermined	Coal washery
Huff Junction	50	Undetermined	(1)
Three Forks	250	Undetermined	(1)
Pardee	20	Undetermined	(1)
Lorado	350	New plant	—
Lorado Coal Mining Co.	—	Undetermined	Coal washery
Craneco	1,590 combined	Undetermined	(1)
Lundale		Undetermined	(1)
Logan County Coal Corp.	—	Undetermined	Coal washery
Stowe	200	Undetermined	(1)
Latrobe	200	Undetermined	(1)
Crites	200	Undetermined	(1)
Robinette	400	Undetermined	(1)
Amherstdale	2,910	Undetermined	(1)
Guyan Eagle Coal Co.	—	Undetermined	Coal washery
Amherst Coal Co. (Amherstdale)	—	Undetermined	Coal washery
Braeholm	758	Undetermined	(1)
Accoville	1,075	Undetermined	(1)
Amherst Coal Co. (Accoville)	—	Undetermined	Coal washery
Crown	250	Undetermined	(1)
Kistler	1,061	Undetermined	(1)
Ario	10	Undetermined	(1)
Slagle	700	Undetermined	(1)
Logan County Coal Corp.	—	Undetermined	Coal washery
Yolyn	245	Undetermined	(1)
Argyle	200	Undetermined	(1)
McBeth	400	Undetermined	(1)
Orville	200	Undetermined	(1)
Hutchinson	400	Undetermined	(1)
Hutchinson Coal Co.	—	Undetermined	Coal washery
Dehue	100	Replacement	—

See footnotes at end of table.

Table I_9. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Youngstown Mines Corp.	—	Undetermined	Coal washery
Hetsel	554	Undetermined	(1)
Moran	100	Undetermined	(1)
Ethel	150	New plant	—
Ethel Chilton Mines, Inc.	—	Undetermined	Coal washery
Wanda	300	Undetermined	(1)
Red Campbell	—	Undetermined	(1)
Fort Branch	1,233	Undetermined	(1)
Foley	704	Undetermined	(1)
Sarah Ann	400	Undetermined	(1)
Stirrat	250	New plant	—
W. Va. Coal & Coke Corp. (Stirrat)	—	New plant	Coal washery - Plans under preparation
Barnabas	1,179	Undetermined	(1)
Omar	900	New plant	—
W. Va. Coal & Coke Corp. (Omar)	—	New plant	Coal washery - Plans under preparation
Chauncey	633	Undetermined	(1)
Micco	686	Undetermined	(1)
Switzer	663	Undetermined	(1)
Rossmore	500	Undetermined	(1)
Monaville	1,022	Undetermined	(1)
Wilkinson (Monitor)	762	Undetermined	(1)
Monitor Coal & Coke Co.	—	Undetermined	Coal washery
Mt. Gay	698	Undetermined	(1)
Gay Coal & Coke Co.	—	Undetermined	Coal washery
Shegan	600	Undetermined	(1)
Argonne	57	Undetermined	(1)
Manus	—	Undetermined	(1)
Verdunville	500	Undetermined	(1)
Island Creek Coal Co. (Verdunville)	—	Undetermined	Coal washery
Holden	1,000	New plant	—
Island Creek Coal Co. (Holden)	—	Undetermined	Coal washery
Cora	505	Undetermined	(1)
Whitman	1,500	Undetermined	(1)
Island Creek Coal Co. (Whitman)	—	Undetermined	Coal washery
Hamlin[2]	950	Replacement	—
Milton[2]	700	New plant	—
Milton Canning Co.	—	Undetermined	—
Culloden	110	Undetermined	(1)

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Organic industrial waste load is expressed in terms of population equivalent as measured by B.O.D.

[1] No community sewerage system.

[2] Incorporated municipalities in West Virginia.

[3] Huntington, W. Va., discharges to both the Ohio and Guyandot Rivers. Tabular data for this city are included with the Ohio Main Stem Sub-Basin and are excluded from the Guyandot River Sub-Basin.

BIG SANDY RIVER SUB-BASIN

General Description

The Big Sandy River and its two major tributaries, Tug and Levisa Forks, drain an area of 4,280 square miles in eastern Kentucky, southern West Virginia and western Virginia. Of this area, about 2,280 square miles are in Kentucky, 985 are in West Virginia and 1,015 are in Virginia. The sub-basin is irregular in shape and extends from the headwater area in Virginia and West Virginia in a generally northerly direction to Catlettsburg, Ky., where the Big Sandy joins the Ohio River. The Big Sandy River is formed by the junction of Tug Fork and Levisa Fork at Louisa, Ky., about 27 river miles above Catlettsburg. The entire Kentucky-West Virginia border is defined by the Big Sandy River and Tug Fork. The topography of the sub-basin is generally rugged. The greater portion of the area is mountainous and the streams flow in deep, narrow valleys. In the lower portion of the sub-basin, however, the valleys are relatively wide and the mountains give way to gentle, rounded hills.

Economic Development

Included within the area of the sub-basin is a considerable portion of one of the greatest bituminous coal fields in the country. For many years coal mining has been the predominant industrial activity. Following coal production, in approximate descending order of economic importance, are agriculture, gas and oil production, and lumbering. Agricultural development is limited by the rugged nature of the terrain. Crop farming, confined almost wholly to the narrow valley bottoms and to the more gently sloping hillsides, is primarily of the subsistence type, and livestock raising is of some local importance. The production of petroleum and natural gas is principally limited to a few counties in Kentucky, although gas reserves are distributed throughout the sub-basin. Lumbering operations have declined greatly with the depletion of virgin timber, but are still of considerable importance in the upper areas of the sub-basin.

Rainfall and Runoff

The average annual rainfall in the sub-basin is about 45 inches and normally ranges from 40 to 50 inches. The extremes on record through 1944 are 27 inches (1930) and 56 inches (1935). The precipitation is fairly uniform throughout the sub-basin; the annual average for the lower portion is about 44 inches and for the upper portion about 47 inches. The mean annual runoff of both Levisa Fork and Tug Fork has been slightly more than one cubic foot per second per square mile of drainage area. Levisa Fork at Paintsville, Ky., has had an average discharge of 2,172 cubic feet per second for a period of 18 years (1929-47). The drainage area above this station is 2,143 square miles. Tug Fork, near Kermit, W. Va., has had an average discharge of 1,211 cubic feet per second for a period of 13 years (1934-47). This drainage area is 1,185 square miles. The minimum recorded daily discharge for Levisa Fork at Paintsville was 8.4 cubic feet per second (1930) and for Tug Fork at Kermit, 23 cubic feet per second (1939).

Major River Developments

A navigation system consisting of five locks and dams, three on the main stream and one on each of the forks, provides a six-foot navigation channel from the Ohio River to points 12.5 miles up Tug Fork and 17.5 miles up Levisa Fork. The system is reported to be inadequate for modern navigation and is considered obsolete. It is little used except near the mouth of the Big Sandy River. The Corps of Engineers, Department of the Army, has produced a plan of development for the Big Sandy River and its tributaries in conjunction with the comprehensive plan of development for the Ohio River Basin. One Corps of Engineers project, the Dewey Reservoir, is located on Johns Creek which discharges into Levisa Fork about 9 miles above Paintsville. This reservoir is under construction and will serve both in flood control and in low water regulation. Three more flood control projects have been authorized but not started. All three are to be located on Levisa Fork or its tributaries; one, Clintwood Reservoir, is to be located on the Pound River, another, Haysi Reservoir, is to be located on Russell Fork above Haysi, and the third, Fishtrap Reservoir, is to be located on Levisa Fork above the mouth of Russell Fork.

Population

The sub-basin had a population of approximately 411,900 in 1940, according to the census reports of that year. This figure does not include the population of those portions of Catlettsburg, Ky., and Kenova, W. Va., which actually lie within the boundaries of the sub-basin. All data for these two cities are included in the data for the Ohio River main stem. There are no large cities in the sub-basin. The 1940 census lists only 8 towns with a population greater than 2,500 and none with a population greater than 10,000. The total 1940 population of 120 of the 128 communities contributing significant amounts of wastes to the streams was about 134,600. Population data for the remaining 8 locations have not been obtained.

Water Uses

Surface waters in the Big Sandy Sub-Basin are utilized for domestic supplies, waste disposal, coal washing, recreation and navigation. Twenty-four communities are served by 17 water systems which use surface streams as a source of all or part of their required water. These water supply systems serve a combined population of about 53,000. A number of coal washing plants are located along the streams in the coal producing areas of the sub-basin. The streams are used quite extensively by local residents for recreational purposes and for livestock watering. Commercial navigation is limited to the Big Sandy River and the lower portions of Tug and Levisa Forks. The system of locks and dams is obsolete, so the streams are little used for navigation except near the mouth of the Big Sandy River.

Sources of Pollution

One hundred and fifteen communities discharge significant amounts of domestic wastes to the streams of the sub-basin. Thirty-six of these communities, with sewerage systems serving a combined population of about 51,200, discharge wastes with a population equivalent of about 51,000. The latter figure represents the combined known domestic and industrial waste loads, treated and untreated, discharged to streams through municipal sewerage systems. Seventy-four communities, with a combined population of about 66,800, discharge wastes with an undetermined population equivalent. For the remaining 5 communities, no population data are available and the population equivalent of their wastes has not been determined. Of the 54 industrial sources of pollution in the sub-basin, only one produces organic wastes. The wastes from this plant have a B.O.D. population equivalent of 4,800. Coal washing wastes containing coal fines and other inert material are discharged to the streams. Acid mine drainage, while it has no significant effect on any of the larger streams, causes damage on some of the smaller tributaries.

Effects of Pollution on Water Uses

A number of public water supply sources are subject to the effects of pollution by wastes discharged at upstream locations. The health menace to the communities thus served is especially serious during months of low flow. Local nuisance conditions exist along the streams below numerous points of domestic waste discharge. Pollution also limits the use of the streams for recreational purposes and damages aquatic life. Coal washing wastes cause local discoloration of the streams below their points of discharge, and acid mine drainage causes damage to aquatic life in some of the headwater tributaries in the older coal mining areas.

Treatment Provided

Tables C_{10}, D_{10} and E_{10} present data concerning the status of waste treatment in the sub-basin. Of the 115 municipal sources of pollution, 6 are served by primary treatment plants, one is served by a secondary treatment plant, and 108 have no treatment facilities. Six of the 54 industrial plants which discharge wastes to the watercourse provide some kind of waste treatment.

Treatment Plants Required

Table G_{10} contains summary data relative to waste treatment plant requirements in the sub-basin. Table I_{10} lists individual municipal and industrial projects. Twenty-three new plants are required at municipal sources of pollution. Additional facilities are needed at one existing plant. The requirements for 89 communities have not been determined. New waste treatment plants are required at 19 industrial sources and enlargement or additions to existing facilities are required at three. The requirements at 23 industrial sources have not been determined.

Tabular Data

Tables A_{10} through I_{10} contain data relative to water pollution in the sub-basin. There are many minor sources of pollution by domestic wastes for which data could not be included. Many privies, for example, are build over streams or along stream banks and the practice of disposing of garbage and other refuse by dumping it into the streams is common in the area.

Table A_{10}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	36	51,198	51,048
Having population data available (Data on pollution load to watercourse incomplete or not available)	79[1] [2]	66,836[1]	Not applicable
Total	115[1] [2]	118,034[1]	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 59 communities having no comprehensive public sewerage systems, but for which population data are available. These 59 communities have an estimated combined population of 42,206.

[2] Includes 5 communities having no comprehensive public sewerage system, and for which no population data are available.

Table B_{10}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	1**	4,800
Producing organic wastes	0	Undetermined
Producing inorganic wastes	54	Not applicable
Producing wastes of undetermined type	0	—
Total	54[1]	—

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes one plant also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus, **.

Table C_{10}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	6	7[1]	5,250
Secondary	1	1	2,000
No treatment	108[2] [3]	—	110,784[2]

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

[1] Includes one plant serving two communities and 3 plants serving one community.

[2] Includes 59 communities having no comprehensive public sewerage system, but for which population data are available. These 59 communities have an estimated combined population of 42,206.

[3] Includes 5 communities having no comprehensive public sewerage system, and for which no population data are available.

Table D_{10}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Products of petroleum and coal	3	1	2	0
Primary metal industries	1	0	0	1
Coal washing	47	5	1	41
Miscellaneous	3	0	0	3
Totals	54	6	3	45

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{10}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	8*	1	4 [1]	3 [2]	1	0	7
Industrial	6	3	1	2	5	0	2

*8 treatment plants serving 7 communities. One treatment plant serves 2 communities and 3 treatment plants serve 1 community.

[1] 3 plants serve 1 community.

[2] 1 plant serves 2 communities.

Table F_{10}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	0	—	2	Inorganic
1949	0	--	1	Inorganic

Table G_{10}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**[1]	Population served by facilities	Number**[1]
New plant	23[2]	38,813	19
Enlargement or additions to existing plant	1[3]	500	3
Replace existing plant	0	0	0
No project required	2	2,300	9
Undetermined	89[4][5][6]	76,421[4]	23

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by preceding tables. See discussion under "Pollution Prevention Measures Required" part I of the report.

[2] Includes one location having treatment for a part of the population. Requires a new plant for entire community.

[3] One community served by 3 plants.

[4] Includes 59 communities having no comprehensive public sewerage systems but for which population data are available. These 59 communities have an estimated combined population of 42,206.

[5] Includes 5 communities having no comprehensive public sewerage system, and for which no population data are available.

[6] Includes 2 locations served by one plant.

Table H_{10}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	12	30
Abatement ordered	0	0
Plans under preparation	0	9
Final plans approved	2	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	99	6

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_{10}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Virginia:			
Bishop	560	New plant	—
Keen Mountain	500	Additions	Need secondary treatment units
Grundy	1,550	New plant	—
H. E. Harman Coal Corp.	—	Undetermined	Coal washing
Pound	200	New plant	—
Clintwood	1,600	New plant	—
McClure	250	New plant	—
Clinchco	545	New plant	—
West Virginia:			
Fort Gay[1]	100	New plant	—
Laval Sand Co.	—	Undetermined	—
Prichard	—	Undetermined	(1)
Jenkinjones	2,231	Undetermined	—
Pocahontas Fuel Co., Inc.	—	Undetermined	Coal Washing
O'Toole	619	Undetermined	(2)
Pageton	1,338	Undetermined	—
Page Coal & Coke Co.	—	Undetermined	Coal washing
Thorpe	1,582	Undetermined	—
Venus	659	Undetermined	(2)
Gary	1,000	Undetermined	—
Wilcoe	942	Undetermined	(2)
Havaco	831	Undetermined	—
Welch[1]	5,850	New plant	Final plans approved
Hemphill	500	Undetermined	(2)
Capels	1,189	Undetermined	(2)
New R. & Pocahontas Cons. Coal Co.	—	Undetermined	Coal washing
Mohegan	522	Undetermined	(2)
Sawyers & Peyatt Coal Co., Inc.	—	New plant	Coal washing - Plans under preparation
Davy	1,400	Undetermined	—
Marytown	500	Undetermined	(2)
Semet-Solvay Division Allied Chemical & Dye Corp.	—	Undetermined	Coal washing
Claren (Hensley)	652	Undetermined	(2)
Big Sandy	250	Undetermined	(2)
Sandy Huff	549	Undetermined	(2)
Iaeger[1]	550	New plant	—
Litwar (Hull)	400	Undetermined	—
Krollits	150	Undetermined	(2)
Panther	300	Undetermined	(2)
Mohawk	225	Undetermined	(2)
War Eagle	623	Undetermined	(2)
Vulcan	350	Undetermined	—
Matewan[1]	600	New plant	—
Surosa	300	Undetermined	(2)
Lobato	300	Undetermined	(2)
Sprigg	150	Undetermined	(2)
Merrimac	200	Undetermined	(2)
Rawl	200	Undetermined	(2)
Williamson[1]	8,000	New plant	—
Goodman	550	Undetermined	(2)
Borderland	300	Undetermined	—

See footnotes at end of table.

Table I10. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Nolan	812	Undetermined	(2)
Thompson Brown Sand Co.	—	Undetermined	—
Naugatuck	—	Undetermined	(2)
Kermit[1]	811	New plant	—
Grey Eagle	—	Undetermined	(2)
Leckie	708	Undetermined	(2)
Anawalt	1,366	Undetermined	(2)
Filbert	1,730	Undetermined	—
Elbert	977	Undetermined	(2)
Ream	1,058	Undetermined	(2)
Maybeury	6,427	Undetermined	—
Pocahontas Fuel Co.	—	Undetermined	Coal washing
Switchback	—	Undetermined	Population included with Maybeury
Elkhorn	450	Undetermined	(2)
Crozer Land & Coal Co.	—	Undetermined	Coal washing
Powhatan	500	Undetermined	(2)
Kyle	350	Undetermined	(2)
Northfork[1]	1,090	New plant	—
Keystone[1]	2,200	New plant	—
Eastern Gas & Fuel Association (Keystone)	—	New plant	Coal washery—Plans under preparation
Eckman	1,817	Undetermined	(2)
Landgraff	776	Undetermined	—
Vera Pocahontas Coal Co.	—	New plant	Coal washery
Vivian	2,158	Undetermined	(2)
Peerless Coal & Coke Co.	—	New plant	Coal washery
Kimball[1]	1,000	New plant	—
Big Four	708	Undetermined	(2)
Superior	1,063	Undetermined	(2)
Maitland	766	Undetermined	(2)
Eastern Gas & Fuel Association (Maitland)	—	New plant	Coal washery—Plans under preparation
Crumpler	1,296	Undetermined	(2)
United Pocahontas Coal Co.	—	New plant	Coal washery--Plans under preparation
Ashland	635	Undetermined	(2)
Ashland Coal & Coke Co.	—	New plant	Coal washery—Plans under preparation
Greenbrier	400	Undetermined	(2)
McDowell (Arlington)	861	Undetermined	(2)
Rolfe	642	Undetermined	(2)
Gilliam	547	Undetermined	(2)
Indian Ridge	250	Undetermined	(2)
Algoma	1,132	Undetermined	(2)
Algoma Coal & Coke Co.	—	New plant	Coal washery
Carswell	1,650	Undetermined	—
Eastern Gas & Fuel Association (Carswell)	—	New plant	Coal washery—Plans under preparation
Asco	592	Undetermined	(2)
Premier	997	Undetermined	(2)
Premier Poca. Collieries	—	Undetermined	Coal washery
Six	300	Undetermined	(2)

See footnotes at end of table.

Table I_{10}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
West Virginia--Continued			
Coalwood	3,000	Undetermined	—
Olga Coal Co.	—	Undetermined	Coal washery
Hartwell	729	Undetermined	(2)
Berwind	2,000	Undetermined	(2)
New R. & Pocahontas Cons. Coal Co.	—	New plant	Coal washery
War[1]	1,277	New plant	Final plans approved
Excelsior	509	Undetermined	(2)
Susanna (Yukon)	—	Undetermined	Population included with Caretta
Lomax (Dry Fork)	300	Undetermined	(2)
English	825	Undetermined	—
Bartley	2,200	Undetermined	—
Pond Creek Poca. Co. (Bartley)	—	New plant	Coal washery
Raysal	850	Undetermined	—
Pond Creek Poca. Co. (Raysal)	—	New plant	Coal washery
Bradshaw (Dan)	1,475	Undetermined	—
Garland	523	Undetermined	(2)
Avondale	541	Undetermined	(2)
Squire	—	Undetermined	(2)
Jacob Fork Pocahontas Coal Co.	—	Undetermined	Coal washery
Newhall	700	Undetermined	(2)
Cucumber	1,189	Undetermined	(2)
Warrior Mine	1,000	Undetermined	(2)
Caretta	2,700	Undetermined	Population included Susanna
Olga Coal Co.	—	Undetermined	Coal washery
Jolo	1,303	Undetermined	(2)
Gay Mining Co.	—	Additions	Coal washery--Plans under preparation
Glen Alum	715	Undetermined	(2)
Thacker Mines	513	Undetermined	(2)
Red Jacket	1,000	Undetermined	—
Red Jacket Coal Corp. (Red Jacket)	—	Additions	Coal washery--Plans under preparation
North Matewan	755	Undetermined	(2)
Red Jacket Coal Corp. (Mitchell Br.)	—	New plant	Coal washery
Cinderella	450	Undetermined	—
Sycamore Coal Co.	—	New plant	Coal washery
Chattaroy	1,500	Undetermined	—
Delbarton	1,100	New plant	—
Ragland	350	Undetermined	(2)
Island Creek Coal Co. (Ragland)	—	New plant	Coal washery
Lando Mines	—	Undetermined	(2)
Puritan	1,314	Undetermined	(2)
Lando Coal Corp.	—	New plant	Coal washery
Island Creek Coal Co.	—	New plant	Coal washery
Kentucky:			
Louisa	1,600	New plant	—
Ashland Oil & Ref. Co.	4,800	Additions	—

See footnotes at end of table.

Table I_{10}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
Kentucky--Continued			
Carbide & Carbon Co.	—	New plant	—
Majestic Collieries Co.	—	Undetermined	Coal washery
Leckie Collieries Co.	—	Undetermined	Coal washery
United Fuel Co.	—	New plant	—
Consolidation Coal Co.	—	Undetermined	Coal washery
Jenkins	2,125	New plant	—
Elkhorn City	200	New plant	—
Cinderella Coal Co.	—	Undetermined	Coal washery
Utilities Elkhorn Coal Co.	—	Undetermined	Coal washery
Pikeville	2,880	New plant	—
Premier Elkhorn Coal Co.	—	Undetermined	Coal washery
Diamond Elkhorn Coal Co.	—	Undetermined	Coal washery
Inland Steel Co., Inc.	—	Undetermined	Coal washery
Wayland	200	Undetermined	—
Elkhorn Coal Corp. Mine No. 28	—	Undetermined	Coal washery
Prestonsburg	1,875	New plant	—
Consolidation Coal Co. Mine 155	—	Undetermined	Coal washery
Paintsville	2,850	New plant	—

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Organic industrial waste load is expressed in terms of population equivalent as measured by B.O.D.

[1] Incorporated municipalities in West Virginia.

[2] No community sewerage system.

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SCIOTO RIVER SUB-BASIN

General Description

The Scioto River sub-basin has its headwaters in the north central part of Ohio and flows almost due south to join the Ohio River at Portsmouth, Ohio. Major tributaries include the Olentangy River, Big Walnut Creek, Big Darby Creek, and Paint Creek. The area of the sub-basin is 6,510 square miles, all of which is in Ohio. Most of the sub-basin lies in a highly developed agricultural area.

Economic Development

Agriculture is the predominant industry in the sub-basin. Other industries include processing plants for agricultural products, paper and pulp mills, metal fabricating plants, manufacture of machinery, chemical plants, leather products, clay products, concrete products, lumber products, textile mills and fabricated textile products, furniture products, and other miscellaneous industries.

Rainfall and Runoff

The average annual precipitation in the sub-basin is about 38 inches, the precipitation being slightly greater in the southern part of the sub-basin than in the northern part. Flow data at 25 stream gaging locations are currently reported by the U. S. Geological Survey. Stream flows vary between wide extremes. The gaging station at Columbus, Ohio, shows a minimum recorded flow of 42 cubic feet per second. However, this flow was practically all discharged from city sewers, the water supply for the City being obtained from storage. The natural unregulated flow was probably between 5 and 10 cubic feet per second. Low flows are now regulated by the Columbus water supply reservoirs on the Scioto River and will be further regulated by the flood control reservoir now being completed at Delaware, Ohio, on the Olentangy River. The most critical flow situation on the Main Stem, with respect to pollution abatement, exists at and below Columbus. This situation will be improved to a limited extent by operation of the Delaware Reservoir. Minimum flows in the lower river are generally adequate, along with proper treatment of wastes, to obtain satisfactory stream conditions. Extreme low flows on most of the tributaries will require a high degree of treatment of wastes.

Major River Developments

The Griggs and O'Shaughnessy water supply reservoirs above Columbus, Ohio, and the flood control reservoir on the Olentangy River above Delaware constitute the major river developments in the sub-basin. Studies are being made for further development of a surface water supply for the City of Columbus. Four other reservoirs are authorized in the comprehensive flood control plan of the Corps of Engineers.

Population

The 1940 population in the sub-basin was about 740,000. The 1940 population in municipalities contributing wastes to the streams was about 488,000. It is apparent from table A_{11} that there has been a substantial increase in sewered population since 1940. There has been an increase in Franklin County alone of about 113,000, most of which is tributary to the Columbus sewerage system.

Water Uses

Water uses in the sub-basin include domestic, industrial, and livestock water supplies, and recreational uses. Livestock water uses are important throughout the sub-basin. Water supplies for the Cities of Columbus and Delaware are the only domestic supplies from the main river or major tributaries. Other smaller surface supplies are taken from tributaries. Altogether there are 9 surface water supplies serving more than 400,000 persons. The Columbus supply serves 8 adjoining municipalities and other suburban areas.

Sources of Pollution

There are 55 municipalities (including institutions and other population centers) which contribute significant domestic wastes and connected industrial wastes into the streams of the sub-basin. Thirty-two sources, with a population served of about 150,000, discharge an equivalent population waste load of about 66,000 to the streams. Data on the waste load from 23 sources, having a contributory population of about 464,000, have not been determined. Twenty-seven industrial plants not connected to municipal sewerage systems discharge wastes directly to the streams. Fifteen of these plants discharge an organic waste load equivalent to a population of 83,000. One of these and seven other industries discharge inorganic wastes to the streams. The organic waste loads from five industries have not been determined.

Effects of Pollution on Water Uses

Principal damages to existing water uses are those related to livestock water supplies and recreational uses. Other complaints result from odorous and unsightly conditions of the streams. Damages also occur through restriction of increased uses of the streams for various purposes. Damages to public health are significant, though difficult to evaluate.

Treatment Provided

Of the 55 municipalities discharging wastes to the streams, 13 with a tributary population of 55,000 are served by 14 primary treatment plants; 24 with a tributary population of 537,000 are served by 18 secondary treatment plants; and 18 with a sewered population of about 22,000 have no treatment. One secondary treatment plant, serving several municipalities and 76 percent of the population with treatment facilities, is now being enlarged. Nineteen treatment plants are satisfactory and 13 are unsatisfactory. Of the 19 satisfactory plants, 5 are listed by the State water pollution control agency as needing enlargements or additions to take care of foreseeable population growth. Twelve industrial plants have treatment facilities, 4 of which are satisfactory. Fourteen industrial plants have no treatment, and the status of treatment at one industry is undetermined.

Treatment Plants Required

Table G_{11} contains summary data relative to treatment plant requirements in the sub-basin. Table I_{11} lists individual municipal and industrial projects. Eighteen municipalities require new treatment plants. Three communities, one of which is now served by two plants, require replacements for existing plants. Twenty municipalities require additions to or enlargements of existing plants. Eight of these twenty will be served by the treatment plant enlargement at Columbus, Ohio, and requirements at five more are based on expected increase in load. Fourteen municipalities require no waste treatment projects at the present time.

Seventeen industrial plants require new waste treatment facilities, four require enlargement of or additions to existing facilities and the waste treatment requirements at two are undetermined. Four industrial plants have adequate treatment facilities at the present time.

Tabular Data

Tables A_{11} through I_{11} contain data relative to pollution of the streams in the sub-basin.

Table A_{11}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	32	150,100	66,103
Having population data available (Data on pollution load to watercourse incomplete or not available)	23[1]	463,809[1]	Not applicable
Total	55[1]	613,909[1]	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes 2 communities having no comprehensive public sewerage system but for which population data are available. These communities have an estimated combined population of 1,491.

Table B_{11}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	15**	82,900
Producing organic wastes	5	Undetermined
Producing inorganic wastes	8	Not applicable
Producing wastes of undetermined type	0	—
Total	27[1]	—

*Industries having separate outlets and discharging directly to watercourse.

**Includes one plant also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus, **.

Table C_{11}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	13	14	55,193
Secondary	24	18	536,687
No treatment	18**	—	22,029**

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes 2 communities having no comprehensive public sewerage system, but for which population data are available. These 2 communities have an estimated combined population of 1,491.

Table D_{11}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	16	6	9	1
Paper and allied products..	4	4	0	0
Chemical and allied products................	4	0	4	0
Primary metal industries...	2	2	0	0
Fabricated metal products..	1	0	1	0
Totals..................	27	12	14	1

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{11}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	32*	19[1]	13[2]	0	31	1	0
Industrial	12	4	7	1	9	2	1

*32 plants serving 37 municipalities. Two municipalities have two plants each and one plant serves 8 municipalities.

[1] Includes 2 plants serving 1 municipality.

[2] Includes 1 plant serving 8 municipalities and 2 plants serving 1 municipality.

Table F_{11}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	1	Undetermined
1948	0	—	0	—
1949	1	1,900	0	—

Table G_{11}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	18[1]	22,029[1]	17[2]
Enlargement or additions to existing plant	20[3]	524,395	4
Replace existing plant	3[4]	12,608	0
No project required	14[5]	54,877	4
Undetermined	0	—	2[6]

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Two of these municipalities have no comprehensive public sewerage system. These 2 communities have an estimated combined population of 1,491.

[2] Includes four industries having only minor treatment.

[3] Eight of the 20 municipalities will be served by the treatment plant enlargement at Columbus, Ohio.

[4] One of these now served by two plants.

[5] The 19 treatment plants listed as satisfactory in Table E_{11} serve 18 municipalities. Four of these municipalities are not listed in this table as requiring no project because of needs forseeable in the immediate future.

[6] Includes one industry with no treatment and one with undetermined treatment.

Table H_{11}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	0	16
Abatement ordered	1	2
Plans under preparation	0	4
Final plans approved	4	1
Construction awaiting financing	0	0
Under construction	8**	0
Status undetermined	28	0

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

**Additions being made to one plant at Columbus, Ohio, to serve Columbus and seven other adjoining municipalities or population centers.

Table I_{11}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Ohio:			
Kenton	7,593	New plant	Final plans approved
Kenton Hardware, Co.	—	New plant	Metal toys--plating wastes
La Rue	714	New plant	(1)
Prospect	915	New plant	—
Telling-Belle Vernon	1,200	New plant	—
Columbus	450,000	Enlargement	Under construction
Bexley	(2)	—	(3)
Grandview Hts.	(2)	—	(3)
Hanford	(2)	—	(3)
Marble Cliff	(2)	—	(3)
Riverlea	(2)	—	(3)
Upper Arlington	(2)	—	(3)
Worthington	(2)	—	(3)
Circleville	7,982	Additions	—
Container Corp. of America	—	Additions	—
Federal Institutions (Chillicothe, Ohio)	3,600	Replacement	—
Chillicothe	22,000	Additions	—
Alger	811	New plant	—
McGuffey	618	Additions	—
Mt. Victory	645	New plant	—
Mt. Victory Custom Cannery	100	New plant	—
Sani-Pure Dairy	250	New plant	Plans under preparation
Rushsylvania	560	New plant	—
Marion	28,800	Enlargement	Final plans approved
Richwood	1,628	Enlargement	—
West Mansfield	739	New plant	—
Dutchland Farms Creamery	300	New plant	—
Asman Packing Co.	200	Undetermined	—
North Electric Co.	—	New plant	Plating wastes
Plymouth Stamped Metal Company	—	New plant	Plating wastes
Caledonia	150	New plant	—
Mt. Gilead	2,008	Replacement	Served by 2 treatment plants
Cardington	1,304	New plant	Final plans approved
Sunbury	846	Enlargement	—
Westerville	3,646	Enlargement	—
Kilgore Manufacturing Co.	—	New plant	Electroplating wastes; plans under preparation
E. G. Buchsief	—	New plant	Rendering plant
Ashley	762	New plant	—
Pleasantville	572	New plant	—
Baltimore	1,000	New plant	—
Canal Winchester	1,046	Enlargement	—
Winchester Canning Co.	1,800	New plant	—
Groveport	1,052	New plant	—
Ashville	1,101	Enlargement	—
Crites Milling Co. (Ashville)	—	New plant	Cannery
Fairfield Paper Co.	—	Enlargement	Final plans approved
Pickerington Creamery, Inc.	—	New plant	Abatement ordered
Milford Center	686	New plant	—
Plain City	1,385	Enlargement	—

See footnotes at end of table.

Table I_{11}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served **	Project requirements	Remarks
Ohio—Continued			
Armstrong Metal Products...	—	New plant	Electroplating wastes
Mt. Sterling................	1,115	Enlargement	—
Anderson's Market...........	200	Undetermined	Packing house
Greenfield..................	4,228	Enlargement	—
Mead Corp.	35,000	Additions	Paper mill; plans under preparation
Chillicothe Paper Co.......	2,500	Additions	Plans under preparation
Jeffersonville..............	785	New plant	Final plans approved
Sabina......................	1,525	New plant	—
C. W. Swain Canning Company	2,500	New plant	—
Leesburg....................	839	New plant	—
Highland Co. Canning Company..................	1,800	New plant	—
New Holland.................	777	New plant	(1)
Crites Milling Co. (New Holland)............	3,000	New plant	Cannery
Jackson.....................	7,000	Replacement	Abatement ordered
Cambria Packing Co.........	1,000	New plant	Abatement ordered

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Organic industrial waste load is expressed in terms of population equivalent as measured by B.O.D.

[1] No comprehensive public severage system.

[2] Included with population served for Columbus.

[3] Served by Columbus sewage treatment plant.

LITTLE MIAMI RIVER SUB-BASIN

General Description

The Little Miami River Sub-Basin lies wholly within the State of Ohio, and covers an area of 1,755 square miles in the southwestern part of the State. Originating in Clark County, the Little Miami flows southwesterly for about 100 miles, joining the Ohio River near the eastern boundary of Cincinnati. Free from significant rapids, the stream has a uniform gradient of about 6.5 feet per mile.

Economic Development

Principally an agricultural region, it contains only minor industrial development. Corn and garden truck are principal crops, and cattle, sheep, and hogs are raised extensively. Municipalities in the sub-basin are essentially trading and distributing centers. Vegetable canneries operate in August and September.

Rainfall and Runoff

The mean annual rainfall for this sub-basin is approximately 39.4 inches. Precipitation recorded at individual stations in the area ranges from 36.47 inches to 46.55 inches annually. There are five stream gaging stations located on the Little Miami and its tributaries. They are at Spring Valley, near Fort Ancient, and at Milford on the Little Miami; near Wilmington on Cowan Creek; and at Perintown on East Fork. Flow records indicate wide annual variations in runoff. In some of the tributaries there occur periods of no flow at times. Minimum flows recorded at the gaging stations are as follows: Spring Valley on the Little Miami, 23 cubic feet per second; near Fort Ancient on the Little Miami, 26 cubic feet per second; Milford on the Little Miami, 32 cubic feet per second; Wilmington on Cowan Creek, no flow at times; Perintown on East Fork, 0.3 cubic feet per second.

Major River Developments

The Little Miami has not been considered with respect to navigation. Two flood-control reservoirs have been proposed and studied by the Corps of Engineers, and these projects have been authorized by the Congress as part of a comprehensive flood control program. One of these reservoirs is to be located on Caesar Creek and the other on East Fork. The future progress of these improvements is not yet scheduled. The impounded water, together with the increased low flow from these reservoirs, would greatly increase the value of these tributaries for recreational uses. It is not anticipated that any increased low flows resulting from the construction of these reservoirs will lessen the required degree of waste treatment at sources of pollution in the Little Miami Sub-Basin. However, there would be benefits due to improved water quality and provision of a greater margin for future development.

Population

The 1940 population of the sub-basin, exclusive of the Cincinnati metropolitan area, was about 135,000. Approximately 35 percent of this population resided in 41 incorporated communities.

Water Uses

There are six communities which use surface waters of the sub-basin as public water supplies. These six public systems serve a population of about 12,000. The surface waters are used throughout the sub-basin for watering livestock. Recreational activities in the area include boating and fishing. There is a growing demand for water recreational facilities, especially in the lower part of the sub-basin near Cincinnati.

Sources of Pollution

At present there are 29 communities, with a total sewered population estimated at 166,500, contributing significant wastes to the Little Miami and its tributaries. This includes a portion of Cincinnati, with a population served of about 113,000, which drains into the Little Miami. It also includes 12 communities, with an estimated combined population of 14,500 which, although having no community sewerage system, are reported to be contributing significant pollution loads to the streams through private sewers.

Industrial wastes of considerable quantity are discharged into the stream through municipal sewers and the treated and untreated combination of these and domestic wastes amounts to a population equivalent of 173,300. In addition, there are six industrial plants which, when operating, discharge through private sewers wastes having a B.O.D. equal to that of a population of about 6,000. These industrial discharges, mostly vegetable cannery wastes, are especially important from a pollution standpoint as they occur during the annual period of low stream flow.

Effects of Pollution on Water Uses

A pollution load with a population equivalent of almost 180,000 surely has considerable effect on the downstream water uses. It should be pointed out, however, that most of this load enters the Little Miami from the Cincinnati area only a few miles above the confluence with the Ohio River. It is expected that this part of the pollution load--with an estimated population equivalent of 150,000--will soon be intercepted and discharged after treatment directly to the Ohio River. Even now, this part of the waste affects only the lower few miles of the Little Miami, and becomes a greater problem in the Ohio River than in the tributary.

Treatment Provided

Two municipalities in the Little Miami Valley have primary sewage treatment and six have secondary treatment. The primary plants serve a total population of 11,500 while the secondary treatment plants provide for a population of 18,800. Six of the eight plants are satisfactory.

There are 21 significant municipal sources of pollution in the sub-basin which provide no treatment of sewage. Of these 21 communities, 12, with a combined population of about 14,500, have no comprehensive public sewerage systems. The remaining nine towns in the "no treatment" category have a combined population of about 122,000.

Three of the six industries in the Little Miami River Sub-Basin which are listed as sources of pollution provide some treatment of industrial wastes. Only one of the industrial treatment facilities is considered adequate.

Treatment Plants Required

Table G_{12} contains summary data relative to treatment plant requirements in the sub-basin. Table I_{12} lists individual municipal and industrial projects. New treatment plants are needed in 8 communities with a combined population served of approximately 121,000. In addition, 12 towns need both sewage collection facilities and new plants. This makes a total of 20 needed new plants. Two communities require enlargements or additions to existing treatment works. The requirements at one location are undetermined. At present, no project is required at six of the 29 communities listed as sources of pollution.

Three of the canneries need new waste treatment facilities, one requires additions to its existing facilities, and one needs to replace its existing treatment facilities. One other cannery has satisfactory facilities for waste disposal and requires no improvements.

Tabular Data

Data summarizing the stream pollution status of the Little Miami River Sub-Basin are presented in Tables A_{12} through I_{12}. The estimate of wastes discharged to this sub-basin is believed reasonably complete. There is one industrial plant, a cannery, for which there is no recent estimate of the waste load. A report dated eleven years ago estimated the wastes from this plant as having a population equivalent of 600 as measured by B.O.D.

The sources of pollution listed include those 12 communities, already mentioned, which have no community sewerage system, but are known to be contributing significant wastes to surface streams. There are additional minor sources of pollution at numerous small population centers scattered throughout the sub-basin.

Table A_{12}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	29[1]	166,489[1]	173,290[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	0	0	Not applicable
Total	29[1]	166,489[1]	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes data for 12 communities having no comprehensive public sewerage system, but for which estimates of pollution loads discharged to streams are available. These 12 communities have an estimated combined population of 14,489. Also includes data for a portion of Cincinnati, with an estimated population of 113,000 from which a combined municipal and industrial pollution load with a population equivalent of about 150,000 is discharged to the Little Miami.

Table B_{12}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	5	5,600
Producing organic wastes	1	Undetermined
Producing inorganic wastes	0	Not applicable
Producing wastes of undetermined type	0	—
Total	6	—

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_{12}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	2	2	11,500
Secondary	6	6	18,800
No treatment	21	—	136,189**

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes 12 communities having no comprehensive public sewerage system, but for which estimates of pollution loads discharged to streams are available. These 12 communities have an estimated combined population of 14,489.

Table D_{12}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	6	3	3	0
Total....................	6	3	3	0

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{12}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	8	6	2	0	8	0	0
Industrial	3	1	2	0	2	1	0

Table F_{12}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	1	5,000	0	—
1949	0	—	0	—

Table G_{12}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	20[1]	135,589[1]	3
Enlargement or additions to existing plant	2	11,500	1
Replace existing plant	0	—	1
No project required	6	18,800	1
Undetermined	1[2]	600	0

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Includes data for 12 communities having no comprehensive public sewerage system, but for which estimates of pollution loads discharged to streams are available. These communities have an estimated population of 14,489.

[2] Although this small community has no treatment at present, project requirements, if any, have not been determined.

Table H_{12}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	4	3
Abatement ordered	0	0
Plans under preparation	1	0
Final plans approved	10	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	8	0

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_{12}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Ohio:			
Clifton	187	New plant	(1)
Spring Valley	468	New plant	(1)
Roxana Canning Plant	1,500	New plant	—
Waynesville	800	New plant	Final plans approved
Waynesville Cannery	1,500	New plant	—
South Lebanon	746	New plant	(1)
Kings Mills	800	New plant	(1)
Loveland	1,500	New plant	Final plans approved
Milford	2,000	New plant	Final plans approved
Cincinnati area (Duck Creek Sewer)	113,200	New plant	Plans under preparation
Cedarville	600	Undetermined	Final plans approved
Suburban Conservancy Dist. S.E. of Dayton	9,000	New plant	Final plans approved[1]
Bellbrook	410	New plant	(1)
Spring Valley Packing Company	800	New plant	—
Harveysburg	354	New plant	(1)
Clarksville	430	New plant	(1)
Wilmington	5,000	Additions	Final plans approved
Blanchester	1,200	New plant	Final plans approved
C.E. Bates Company	800	Replacement	Cannery
Lebanon	6,500	Additions	Final plans approved
Mason	600	New plant	(1)
Mason Canning Co.	200	Additions	—
New Vienna	400	New plant	(1)
Lynchburg	400	New plant	—
Fayetteville	394	New plant	(1)
Williamsburg	700	New plant	(1)
Batavia	1,000	New plant	Final plans approved
Bethel	1,000	New plant	Final plans approved

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Industrial organic waste load is expressed in population equivalent as measured by B.O.D.

[1] No comprehensive public sewerage system.

LICKING RIVER SUB-BASIN

General Description

The Licking River is approximately 300 river-miles long and drains an area of about 3,670 square miles in eastern Kentucky. The river flows in a northwesterly direction from its headwaters to discharge to the Ohio River between Covington and Newport, opposite Cincinnati. The upper portion of the sub-basin lies in the mountainous regions of eastern Kentucky, while the lower portion passes through the fertile blue-grass territory.

Economic Development

Agriculture is the chief economic pursuit in the sub-basin. Coal mining was formerly an important industry in the upper mountainous area of the sub-basin. This industry is not very active at the present time. As a result, there are numerous abondoned mines in the area and little effort has been made to reduce acid mine drainage. There are but few important manufacturing plants in the sub-basin and most of these are concerned with processing agricultural products.

Rainfall and Runoff

The mean annual rainfall in the sub-basin is approximately 45 inches. Runoff is fairly rapid and stream flows fluctuate greatly, ranging downward from a maximum of 80,000 cubic feet per second in the lower river. An analysis of 20 years of record at Catawba, Ky., (drainage area about 90 percent of the total sub-basin area) shows three years having minimum flows below 15 cubic feet per second and four years below 25 cubic feet per second. The minimum mean monthly flow for the 20-year period was 5.49 cubic feet per second in October 1930. Wastes discharged to tributaries must, in most instances, receive a high degree of treatment to prevent local nuisances.

Major River Developments

The river has not been developed for navigation nor have other major improvements been made. Studies by the U. S. Army Corps of Engineers have included consideration of flood control and hydroelectric power developments. Two proposed reservoirs, both on the main stem, are included in the comprehensive flood control plan for the Ohio River Basin. Flow regulation from these reservoirs would not reduce treatment plant requirements in the greater part of the sub-basin, but would be of benefit in maintaining improved water quality in the lower portion of the sub-basin.

Population

The total 1940 population in the sub-basin was about 189,300. Of this total, the 1940 population of municipalities now listed by the State water pollution control agency as contributing significant wastes to the streams was about 35,600.

Water Uses

Eleven of the larger public water supplies are from surface sources and serve approximately 34,000 persons. One of these obtains the water supply from the Kentucky River Sub-Basin. There are other smaller supplies from surface sources. The waters from the main stem and from the South Fork are also used for industrial water supplies. Other uses of the streams include livestock water supplies, fishing, bathing and other recreation.

Sources of Pollution

Fourteen municipalities contribute significant wastes to the streams. The population served by sewers in these municipalities is estimated to be about 27,000. It is estimated that the waste load from these municipalities is reduced about 55 percent by existing treatment. Eight industrial plants discharge a waste load equivalent to a population of about 31,000. Two other plants discharge an undetermined amount of organic wastes. Four plants contribute wastes not measured in terms of population equivalent, three being steel and metal fabricating plants and one being an oil refinery. Acid mine drainage may contribute to the pollution of these streams, although the extent of this waste and remedial measures required have not been determined.

Effects of Pollution on Water Uses

The total volume of waste discharged into the streams in the sub-basin is comparatively small. However, in order to prevent local nuisances, a high degree of treatment appears warranted in most cases, since the amount of dilution water available during prolonged dry periods is small. Acid mine drainage may cause some damage to the streams in the upper mountainous area of the sub-basin, but

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the extent of any such damage has not been determined.

Treatment Provided

Of the fourteen municipalities contributing wastes to the streams of the sub-basin, two have primary treatment facilities serving a population of about 2,700, three have secondary treatment facilities serving a population of about 16,300; and nine, with a combined population of about 8,000, have no treatment facilities. Fourteen industrial plants discharge wastes to the streams. Of these, two provide treatment for organic wastes, one provides treatment for inorganic wastes and eleven have undetermined or no treatment facilities. Tables C_{13}, D_{13} and E_{13} contain data on existing treatment facilities.

Treatment Plants Required

Table G_{13} contains summary data relative to treatment plant requirements for the Licking River and its tributaries. Table I_{13} lists individual municipal and industrial projects. New treatment plants are required by the nine municipalities now having no treatment facilities and replacement plants are required by the two municipalities now providing primary treatment. The three plants providing secondary treatment are adequate at the present time. Of the fourteen industrial plants discharging wastes to the water course, eleven require new treatment plants, one requires additions to an existing plant and two require replacement plants.

Tabular Data

Tables A_{13} through I_{13} present data related to stream pollution in the sub-basin. Table A_{13} is incomplete with respect to the estimate of waste discharged to the stream. Table I_{13} contains a list of municipalities and industries for which it has been determined that new or improved waste treatment facilities are required. In addition, corrective measures may be required for abandoned coal mines and for minor sources of pollution at small population centers.

Table A_{13}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	1	990	1,090
Having population data available (Data on pollution load to watercourse incomplete or not available)	13	26,040	Not applicable
Total	14	27,030	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

Table B_{13}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	8**	31,300
Producing organic wastes	2	Undetermined
Producing inorganic wastes	4	Not applicable
Producing wastes of undetermined type	2	Undetermined
Total	14[1]	—

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 2 plants also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus, **.

Table C_{13}. Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipal-ities*	Plants	
Primary	2	2	2,700
Secondary	3	3	16,300
No treatment	9	—	8,030

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

Table D_{13}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products.	8	2	6	0
Products of petroleum and coal................	1	1	0	0
Fabricated metal products.	3	0	3	0
Undetermined.............	2	0	2	0
Totals..................	14	3	11	0

*Industries having separate outlets and discharging directly to watercourse.

Table E_{13}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	5	3	2	0	3	2	0
Industrial	3	0	2	1	0	2	1

Table F_{13}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	None	—	0	—
1947	None	—	0	—
1948	1	12,000	0	—
1949	1	5,600	0	—

Table G_{13}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	9	8,030	11
Enlargement or additions to existing plant	0	—	1
Replace existing plant	2	2,700	2[1]
No project required	3	16,300	0
Undetermined	0	—	0

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] One plant is listed in table E as undetermined with respect to capacity.

Table H_{13}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	0	14
Abatement ordered	0	0
Plans under preparation	0	0
Final plans approved	1	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	10	0

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_{13}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Kentucky:			
Salyersville..................	500	New plant	—
West Liberty..................	760	New plant	—
Morehead......................	2,300	Replacement	—
Owingsville...................	400	Replacement	—
Flemingsburg..................	450	New plant	—
Falmouth......................	990	New plant	—
Butler........................	150	New plant	—
Walton........................	200	New plant	—
Williamstown..................	180	New plant	—
Walton Packing Co.............	800	New plant	—
Sohio Petroleum Co. (Latonia)	19,000	Additions	—
Pebbleford Distillery.........	1,400	New plant	—
Joe. N. Rice Co...............	1,500	Replacement	—
Andrews Steel Co..............	3,200	New plant	Also acid waste
Jersey Farm Co................	—	New plant	—
Becker Bros...................	—	New plant	Type of waste not reported
Highland Dairy................	—	New plant	—
Koch Co.......................	—	New plant	Type of waste not reported
Grote Manufacturing & Grotelite Co...............	—	New plant	Fabricating metal
International Detrola Co......	—	New plant	Fabricating metal
Millersburg...................	500	New plant	—
Jos. E. Seagram & Son.........	5,000	Replacement	—
Cynthiana.....................	4,300	New plant	Final plans approved
Kentucky Cardinal Dairies, Inc..........................	200	New plant	—
A. J. Hatterick...............	200	New plant	—

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B.O.D.

MIAMI RIVER SUB-BASIN

General Description

The Miami River, with a total watershed of 5,385 square miles, collects and carries to the Ohio River the drainage from 3,950 square miles in southwestern Ohio and from 1,435 square miles in southeastern Indiana. Rising in Logan County, Ohio, the Miami flows southwest, joining the Ohio River at the Indiana-Ohio State boundary line. Most of that part of the valley in Indiana is drained by the Whitewater River, the principal tributary of the Miami River. The Whitewater joins the Miami at a point 5 miles above the mouth of the latter.

The headwaters of the Miami have an elevation of more than 1,200 feet above sea level. The river falls at a fairly uniform rate to about 500 feet at the Ohio River. This amounts to a drop of 700 feet or more in a distance of 160 miles.

Economic Development

The Miami River Sub-Basin is well developed industrially. The area is well served by railroads. Metal and paper are important products, while canneries, textile mills, and cement plants account for a substantial part of the manufacturing industries. Although industrial activities in the Miami River Valley predominate, agriculture is also important. Much of the rural area is plowed or grazed.

Rainfall and Runoff

The average annual precipitation for the sub-basin is approximately 40 inches, distributed fairly evenly throughout the year. At Hamilton, Ohio, the precipitation for a 27-year period was 40.83 inches. During this same period the minimum average monthly precipitation was 2.21 inches for February, while the maximum average was 4.08 inches for the month of March.

Records of the U. S. Geological Survey show a wide range of runoff for the Miami River. Over a period of 28 years through September 1947, the average discharge at Hamilton was 3,282 cubic feet per second from a drainage area of 3,639 square miles. During that period the flow has varied from a minimum of 100 cubic feet per second to a maximum of 352,000 cubic feet per second. A frequency analysis of low flows at Hamilton indicates that a mean monthly summer flow of 410 cubic feet per second may be expected to occur at an average interval of ten years.

Major River Developments

The Miami River is not navigable and has never been improved for navigation. Power has been developed to some extent, mainly in small, run-of-river type projects. The Miami Conservancy District completed five flood-retarding dams in 1922. The Corps of Engineers, Department of the Army, has conducted extensive surveys in the Miami Valley in connection with navigation, water power, flood control, and irrigation. Two flood-control dams have been authorized for construction on the East and West Forks of the Whitewater River in Indiana. No expenditure of funds seems justified for power, irrigation, or navigation projects in the Miami River Sub-Basin.

Population

The Miami Valley had a population of approximately 830,500 in 1940, of which more than 60 percent was urban. Complete 1950 census figures are not yet available, but preliminary counts indicate a substantial increase over the 1940 census. The State of Ohio, according to the Bureau of the Census, has experienced an increase of some 14 percent over the 1940 population. A similar increase is expected to have taken place for the Miami Valley portion of the State. The 1940 population of 56 of the 62 municipalities listed by State water pollution control agencies as significant sources of pollution was about 539,300.

Water Uses

Most localities in the Miami River Sub-Basin have a plentiful supply of ground water for domestic and industrial use. Of more than 50 public water supplies, only four obtain all or part of their water from surface sources. These four systems supply water to approximately 18,400 persons. Springfield, Ohio, with an infiltration gallery supplying water to a population of some 71,000, is considered by the State health department to have a surface supply, since the gallery is recharged largely from Buck Creek.

Livestock watering is a common use of surface waters throughout the Valley, especially along the smaller streams tributary to the main stream. Fish and wildlife propagation are important uses of some of the streams. Fishing and other forms of aquatic sports are popular in some of the waters, notably in the upper reaches of the Miami itself, in Stillwater River, Mad River, Twin Creek, and Whitewater River.

Sources of Pollution

The following information on pollution in the Miami River is based largely on a survey conducted throughout the sub-basin in 1949 by the mobile laboratory unit of the Ohio Department of Health. The Whitewater River data were furnished by the Stream Pollution Control Board of Indiana.

Significant amounts of wastes find their way into the waters of the Miami and its tributaries from 62 municipalities and 53 industries. The municipalities have a sewered population of some 707,000, of which more than half is concentrated in 6 cities. Domestic sewage and industrial wastes in the public sewerage systems of 52 communities, after some treatment in municipal sewage disposal plants, are reduced to a population equivalent of about 395,000. In addition, 34 industries discharge through private sewers organic wastes equal in polluting strength to a population of about 482,000. These population equivalent figures do not include 10 towns and 13 industrial plants for which the waste loads discharged to the streams are undetermined. Considerable quantities of inorganic wastes are also discharged by the industries of the valley.

Effects of Pollution on Water Uses

Pollution has had a deleterious effect on the use of the surface waters of the Miami Sub-Basin. The value of the streams has been reduced considerably. While most water supplies in the sub-basin, both municipal and industrial, are from ground sources, those water consumers depending on surface supplies are experiencing ever increasing difficulty and expense in obtaining a satisfactory finished water.

Livestock watering is also affected by wastes in the surface streams. Reports have been received of water unsatisfactory for this purpose at many locations along 25 of the tributaries of the Miami, including the Whitewater River in Indiana. If pollution continues to become progressively worse along those tributaries where livestock are raised, many farmers may be forced to develop or improve ground water supplies at considerable expense. Indeed, many stockmen have already been faced with and have met that necessity.

The effects on the recreational uses of the streams in the area, while not quite amenable to a financial accounting, are nevertheless important. Game fishing is reported to be sharply curtailed in the Mad, Stillwater, and Whitewater Rivers, as well as in several lesser tributaries. On some of the other tributaries, as well as in the Miami itself, there is little or no fishing. Pollution has already made streams unsuitable for most fish and wildlife. They are no longer considered as fishing streams and, consequently, few reports have been received concerning the effects of pollution on fish life in those waters. It is axiomatic that these streams, if sufficiently cleaned up, would again become productive fishing grounds. These same streams, minus pollution, would also serve a large part of the Miami Valley population as convenient recreational playgrounds for bathing, picnicking, and boating. Many persons, if they can afford it, must make dollar-consuming trips to more distant waters for these forms of recreation. Those who cannot afford the expense of travel are too often deprived of these pleasures which are enjoyed by the inhabitants of less polluted areas.

Treatment Provided

Well over half of those municipalities contributing significant pollution to the streams provide at least partial treatment of their domestic wastes. There are 25 secondary treatment plants serving 26 communities with a combined population of about 393,500. Primary treatment is provided in 13 municipalities whose combined population approximates 147,000. No sewage treatment is provided in 23 of those communities contributing significant pollution to the surface waters. These 23 towns have a combined population of approximately 167,000. In addition to the domestic wastes, undetermined but considerable amounts of industrial wastes are also carried in the municipal sewerage systems mentioned above.

Of the 53 industries having private sewers, 14 are known to provide some measure of industrial waste treatment, 38 are known to discharge their wastes untreated, and information concerning treatment or lack of treatment at the one remaining plant is not available. Only one of the 21 paper and pulp plants in the Miami Valley is credited with providing treatment of wastes. Eight of twenty food processing plants have treatment of wastes. Five more disposal plants provide treatment for wastes from two petroleum plants and three metal products plants. One chemical laboratory does not provide treatment for process wastes, but does provide treatment for sanitary wastes.

Of those 38 municipal treatment plants in the Miami River Sub-Basin, 29 are considered satisfactory in design. The remaining 9 are over-loaded and promise to become even more so. Seven of the 14 existing industrial waste treatment plants are adequate, while 2 are known to be inadequate. No information is available concerning adequacy of capacity at 5 industrial waste disposal works.

Treatment Plants Required

A survey of treatment requirements has revealed the need for improvements at 37 communities and at 40 industrial plants. These improvements range from enlargements of existing facilities to entire new plants. The several categories of improvements required are enumerated in Table G_{14}. The project requirements at given pollution sources are listed in Table I_{14}.

Tabular Data

Additional data relative to pollution in the Miami River Valley are included in Tables A_{14} through I_{14}.

Table A_{14}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	52	697,592	394,612
Having population data available (Data on pollution load to watercourse incomplete or not available)	10[1]	9,549	Not applicable
Total	62[1]	707,141	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes one municipality for which no population or waste data are available.

Table B_{14}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	34**	481,963
Producing organic wastes	13	Undetermined
Producing inorganic wastes	12	Not applicable
Producing wastes of undetermined type	0	--
Total	53[1]	—

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 6 plants also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus, **

Table C_{14}. Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	13	13	146,733
Secondary	26[1]	25	393,556
No treatment	23	--	166,852

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

[1] Includes Wright-Patterson Air Field, served by Dayton treatment plant. No estimate of population available.

Table D_{14}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	20	8	12	0
Textile mill products......	1	0	1	0
Paper and allied products..	21	1	20	0
Chemical and allied products................	1	0**	1**	0
Products of petroleum and coal....................	2	2	0	0
Leather and leather products...................	1	0	1	0
Fabricated metal products..	7	3	3	1
Totals...................	53	14	38	1

*Industries having separate outlets and discharging wastes directly to watercourse.
**Treatment is provided for sanitary wastes.

Table E_{14}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	38*	29*	9	0	29	9	0
Industrial	14	7	2	6	7	1	5

*Includes one plant serving two communities.

Table F_{14}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	—	—
1947	0	—	0	—
1948	0	—	4*	**
1949	0	—	1	(1)

*Includes one installation at an industrial plant for treating sanitary sewage only. Status of industrial waste treatment undetermined.
**Population equivalent unknown. Volume of wastes amounts to more than 10 M.G.D.
[1] Population equivalent unknown. Volume of wastes amounts to 4,400 gallons per day.

Table G_{14}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number** [1]
New plant	22	166,319	35
Enlargement or additions to existing plant	14[2]	463,515	5
Replace existing plant	1	9,000	0
No project required	25[3]	68,307	8
Undetermined	0	—	5

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of industrial requirements in this table is not necessarily in accordance with requirements which may be indicated by other tables. See discussion under "Pollution Prevention Measures Required", Part 1 of the report.

[2] Includes Wright-Patterson Air Field, served by Dayton treatment plant. No estimate of population available. Six of these locations, two of which are served by one treatment plant, are listed in table E as satisfactory. The need for enlargement is based on forseeable future increase in loading.

[3] Includes one community now having no treatment.

Table H_{14}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	17	42
Abatement ordered	0	0
Plans under preparation	4	0
Final plans approved	4	2
Construction awaiting financing	0	0
Under construction	2	0
Status undetermined	10	1

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_{14}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Indiana:			
West Harrison	311	New plant	—
Richmond	35,147	Enlargement	Under construction
Liberty	1,496	New plant	Under construction
Cambridge City	2,207	New plant	—
Milton	649	New plant	—
Connersville	13,998	New plant	Plans under preparation
Brookville	2,194	New plant	—
New Lisbon Canning Co.	400	New plant	Lagoon
Dublin	751	New plant	—
Lynn	1,014	New plant	—
Oldenburg	533	Enlargement	—
Ohio:			
Belle Center	835	New plant	—
Sidney	13,500	New plant	Final plans approved
Sidney Tannery	1,770	New plant	—
Stolle Manufacturing Co.	—	New plant	Plating wastes
Piqua	20,000	Additions	—
Troy	12,600	Additions	—
Braun Bros. Packing Co.	4,550	New plant	—
Queen City Paper Co.	7,720	New plant	—
Vandalia	5,000	Additions	—
Dayton	260,000	Enlargement	Part to Miami River, part to Wolf Creek
Wright-Patterson Air Force Base	No estimate	Enlargement	Tributary to Dayton
Aetna Paper Co.	22,000	New plant	—
National Cash Register Co.	8,320	Undetermined	—
Carrmonte Sewer Dist.	4,500	New plant	—
Frigidaire Div., G.M.C.	4,560	Undetermined	Acid wastes
West Carrollton	2,750	New plant	Final plans approved
Miamisburg	6,500	New plant	Plans under preparation
Monsanto Chem. Co Mound Lab.	900	Undetermined	—
Ohio Paper Co.	5,750	New plant	—
Interstate Folding Box Co.	3,050	New plant	—
Maxwell Paper Co.	16,500	New plant	—
Miami Valley Coated Paper Co.	1,700	New plant	—
Middletown	41,500	New plant	Plans under preparation
Sorg Paper Co.	18,400	New plant	—
Wrenn Paper Co.	3,050	New plant	—
Gardner Board & Carton Co.	20,000	New plant	—
Crystal Tissue Paper Co.	8,980	New plant	—
Sall Mountain Paper Co.	4,790	New plant	—
Armco Coke & Blast Furnace Plants	—	Additions	Final plans approved
Hamilton	66,000	New plant	Plans under preparation
Champion Paper & Fiber Co.	141,800	New plant	—
Gulf Oil Refinery	60,700	Additions	Final plans approved
Lakeview	800	New plant	Final plans approved
De Graff	876	New plant	—
De Graff Food Co.	—	New plant	—
Osgood Canning Co.	—	New plant	—
Beckman & Gast Canning Co.	—	New plant	—
Ansonia	783	New plant	—
Pleasant Hill	812	New plant	—
West Milton	1,583	New plant	Final plans approved

See footnotes at end of table.

Table I$_{14}$. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
Ohio—Continued			
Bradford	1,953	New plant	—
Quality Foods	—	New plant	—
Buchy Packing Co.	6,160	New plant	—
Union City	1,647	Additions	—
Arcanum	1,307	New plant	—
Schmitt Canning Co.	—	New plant	(Arcanum)
Schmitt Canning Co.	—	Additions	(Laura)
Netzley Canning Co.	—	Additions	—
Bordens Dairy	658	New plant	—
Springfield	98,000	Additions	—
Fairborne	15,000	Additions	—
Urbana	9,000	Replacement	—
Howard Paper Co.	11,500	New plant	—
United Board & Fiber Co.	12,200	New plant	—
Farm Bureau Co-op	—	New plant	—
Heine Provision Co.	—	New plant	—
Sucher Packing Co.	4,520	New plant	—
Moraine Paper Products	7,000	Additions	—
West Carrollton Parchment Co.	Negligible	Undetermined	Acid waste
Oxford-Miami Paper Co.	65,800	New plant	—
Schell Treon Dairy	53	Undetermined	—
Logan-Long Paper Co.	16,700	New plant	—
Cheney Paper Co.	8,620	New plant	—
Stone Container Co.	12,000	New plant	—
Harding & Jones Paper Co.	1,596	New plant	—
Oxford	8,500	Additions	—
Eaton	5,000	Enlargement	—
Camden	1,000	Additions	—
Glen Karn Canning Co.	—	New plant	—
New Madison Canning Co.	—	New plant	—
New Paris	1,088	Additions	—

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B.O.D.

KENTUCKY RIVER SUB-BASIN

General Description

The Kentucky River Sub-Basin drains approximately 6,940 square miles and discharges into the Ohio River at Carrollton, Ky., about forty miles above Louisville. The sub-basin lies wholly within the State of Kentucky and has headwaters in the mountains of eastern Kentucky, near the Virginia border, about 430 stream miles above its confluence with the Ohio River. The river flows about 200 stream miles through coal-bearing mountainous terrain. After leaving the mountainous area, the river flows about 200 stream miles through the bluegrass section.

Economic Development

The principal economic activities are agriculture in the lower half of the sub-basin and coal mining in the upper, or mountainous half. Cultivation of corn and tobacco, cattle raising, and horse breeding are the principal agricultural pursuits. Whiskey distilling is also an important industry in this sub-basin.

Rainfall and Runoff

Based on available meteorological data, the mean annual rainfall in the sub-basin is about 45 inches, varying from approximately 44 inches in the northern section to 48 inches in the southern section. The extreme minimum monthly precipitation of 0.11 inch occurred in October, and the minimum annual precipitation of 17.49 inches occurred at Carrollton in 1901. The mean precipitation for the minimum month is 2.93 inches for the month of October.

Considerable stream flow data are available for the main stream but are incomplete for the tributaries. The extreme minimum estimated average daily flow at Lockport is about 30 cubic feet per second. The flows in the North Fork and South Fork have dropped to practically nothing on occasions. The minimum monthly flow of record on the main stream at Frankfort, except for 1930, is 350 cubic feet per second. While no attempt is made in this report to consider degree of treatment required at the various sources of pollution, it is indicated that low flows on tributaries and headwater streams will require a high degree of treatment to eliminate local nuisances. Available flow data on the main stream are probably adequate to determine relationships between low flow and treatment requirements. In this connection, all but two municipalities above Frankfort on the main stream have sewage treatment and all of these provide secondary treatment.

Major River Developments

The Kentucky River has been developed for navigation. Locks and dams, numbers 1 to 14 inclusive, provide a 6-foot navigation channel on the main river up to South Fork and North Fork above Beattyville. Consideration has been given to development of flood control and multiple-purpose reservoirs in the sub-basin by the Army Corps of Engineers. The flood control plan includes a reservoir on the main stem above Frankfort and one each on the Middle Fork and South Fork above Beattyville. No information is available as to when these reservoirs may be constructed. Potential pollution abatement benefits from the reservoirs through low-flow regulation are limited to the main stem. Low-flow regulation would improve stream conditions for the various uses. It appears, however, that these would provide but little tangible benefit in reduction of municipal treatment plant requirements. Three municipalities without sewage treatment and one with primary treatment are located on the main stem. Two of these are on the lower river where low-flow regulation would not substantially alter treatment requirements. The other two are small and are located above the proposed main stem reservoir. All other municipalities below the proposed reservoirs have provided secondary treatment of sewage. With respect to benefits to industrial waste treatment, most of the industrial waste is from bourbon whiskey distilleries. Practically all of these plants limit their activity to the period from late fall to early spring. In view of the situation discussed above, it is believed that the pollution abatement program will not be influenced by possible future reservoir development. This should not preclude reviewing the benefits of flow regulation at such time as it may become available.

Another river development is the hydroelectric plant near the mouth of Dix River. The impoundment is known as Lake Herrington.

Population

The 1940 population in the sub-basin was about 482,000. Of this total, the 1940 population in municipalities now listed by the State water pollution control agency as contributing significant wastes to the streams was about 115,500.

Water Uses

Recreational uses of the waters of the sub-basin include fishing, boating, and swimming. Lake Herrington is widely used for all water sports and many cottages are located along the lake. Fifteen of the larger municipalities obtain water from surface sources. In addition, four smaller municipalities obtain water from surface sources. The population served by these surface supplies is about 126,000. Other water uses include industrial and livestock water supplies.

Sources of Pollution

Twenty-four municipalities contribute significant wastes to the streams. The population served by sewers is estimated at about 106,150. Substantial industrial wastes are discharged through municipal sewers in some instances. Twenty-two of the 26 industrial plants producing organic wastes, and not connected to municipal systems, discharge to the streams an equivalent population waste load of about 87,800. About 90 percent of this waste is from distilleries, which operate from late fall to early spring. There is no estimate of the amount of organic waste from the remaining four plants, although it is believed that this waste is comparatively small in amount. Other industries discharge a comparatively small amount of inorganic wastes. Acid mines drainage is discharged into the headwater streams.

Effects of Pollution on Water Uses

In general, the volume of waste discharged to the Kentucky River is small compared to that in some of the more heavily polluted sub-basins. However, short stretches of the river and its tributaries are adversely affected by upstream sources of pollution. During periods of low flow, dissolved oxygen content often reaches very low values, at times even falling to zero. These oxygen-depleted waters often result in damage to fish life. Among other legitimate uses affected by pollution in the sub-basin are domestic and industrial water supply, livestock watering, and bathing.

The significance of acid mine drainage is not clearly defined at present. The damages resulting from these wastes appear to be more extensive in the tributaries than in the Kentucky River itself. Further study of mine drainage wastes appears to be warranted.

Treatment Provided

Of the 24 domestic sources which contribute significant wastes to the streams, one, with a connected population of about 1,200, is served by two primary treatment plants; 15, with a combined population of about 80,000, are served by secondary treatment facilities; and eight, with a combined population of about 25,300, are served by sewerage systems which include no treatment facilities. Thirty-two industrial plants contribute wastes to the watercourse. Of these, 14 have waste treatment facilities, 12 have no treatment facilities, while the existence or absence of treatment at six industries is undetermined. Data with respect to treatment provided and adequacy of treatment are shown in tables C_{15}, D_{15} and E_{15}.

Treatment Plants Required

Table G_{15} contains summary data relative to requirements in the sub-basin. Table I_{15} lists individual municipal and industrial projects. Eight sources of domestic wastes require new treatment plants, three require enlargements or additions to existing plants, and one requires replacement of an existing plant. Of the 32 waste-producing industrial plants, 14 require new waste treatment

Table A_{15}. Sources of pollution, municipal

Municipal-ities*	Sources of pollution (in number of munici-palities)	Population served by sewerage system	Amount of pollution discharged to water-course (in terms of equivalent number of people)**
Having data on pollution load dis-charged to watercourse	1	1,800	600
Having popu-lation data available (Data on pollution load to watercourse incomplete or not available)	23[1]	104,350	Not appli-cable
Total	24	106,150	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes one small institution for which no population data are available.

plants and 5 require enlargements or additions to existing plants. Seven industrial plants have no project required, and the requirements at six more are undetermined.

Tabular Data

Tables A_{15} through I_{15} present data on matters related to stream pollution. These data are incomplete in certain respects and indicate where additional data are needed. The estimate of waste discharged from municipalities is incomplete, the population served being indicated but the effects of treatment and the amount of industrial and domestic waste discharged from municipal systems are not estimated. Table I_{15} contains a list of municipalities and industries for which it has been determined that new or additional treatment of wastes is required. The list also includes six coal washeries for which reports on required treatment have not been made. In addition to those indicated in the tables, there may be minor stream pollution problems at small population centers in the sub-basin.

Table B_{15}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	22	87,850
Producing organic wastes	4	Undetermined
Producing inorganic wastes	6	Not applicable
Producing wastes of undetermined type	0	—
Total	32	--

*Industries having separate outlets and discharging directly to watercourse.

Table C_{15}. Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	1	2	1,200
Secondary	15**	15	79,675
No treatment	8	—	25,275

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes one small institution for which no population data are available.

Table D_{15}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	19	10	9	0
Products of petroleum and coal....................	1	1	0	0
Coal washeries............	6	1	0	5
Undetermined...............	6	2	3	1
Totals..................	32	14	12	6

*Industries having separate outlets and discharging directly to watercourse.

Table E_{15}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	17*	10	7	0	17	0	0
Industrial	14	5	8	1	10	3	1

*17 treatment plants serving 16 municipalities.

Table F_{15}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	1	Undetermined
1947	0	—	0	—
1948	0	—	1	Undetermined
1949	3	11,983	0	—

Table G_{15}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	8	25,275	14
Enlargement or additions to existing plant	3[1]	48,050	5
Replace existing plant	1	1,800	0
No project required	12[2]	31,025	7[3]
Undetermined	0	0	6

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] One municipality is served by two treatment plants.

[2] Includes one small institution for which no population data are available. Also includes two locations not having entirely satisfactory design. These two locations are listed as unsatisfactory in table E.

[3] Includes one industrial plant having no waste treatment but for which no project is required at present.

Table H_{15}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	0	22
Abatement ordered	1	0
Plans under preparation	2	2
Final plans approved	1	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	8	1

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_{13}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Kentucky:			
Beattyville................	525	New plant	—
Texas Co....................	1,700	Additions	—
Irvine......................	3,300	New plant	—
J. N. Culton................	100	New plant	—
James Asbell................	300	New plant	—
Jones & Adams...............	100	New plant	—
Jessamine Canning Co........	900	New plant	—
Kentucky R. Distilling Co..	—	New plant	—
Wilmore.....................	650	Additions	—
Ripy Bros. Distilling Co....	4,700	New plant	—
Dean & Sheck................	2,200	New plant	Studies being conducted
Kraft Phoenix Cheese Corp., Lawrenceburg.............	700	Additions	Studies being conducted
Frankfort...................	10,800	New plant	Plans under preparation
Geo. T. Stagg Co. (Frankfort)..............	16,700	Additions	—
Owenton.....................	1,200	Additions	Abatement ordered
Neon........................	500	New plant	—
Whitesburg..................	1,700	New plant	—
Hazard......................	6,675	New plant	Final plans approved
Jackson.....................	1,250	New plant	—
Manchester..................	525	New plant	—
Stanford Creamery...........	200	Additions	—
F. Keelin Slaughter House..	200	Additions	—
Bernheim Distilling Co.....	2,500	New plant	—
Lexington...................	48,050	Enlargement	—
Lexington Rendering Co.....	50	New plant	—
Julius Kessler Distilling Co.	3,600	New plant	—
Georgetown Packing Co.......	1,000	New plant	—
Elkhorn Canning Co..........	4,400	New plant	—
Parducci Slaughter House...	100	New plant	—
Geo. T. Stagg Distilling Co. (Carrollton)..............	1,400	New plant	—
U.S.P.H.S. Narcotics Farm (Institution).............	1,800	Replacement	Plans under preparation
Consolidation Coal Co.......	—	Undetermined	Coal washing
Kenmont Coal Co.............	—	Undetermined	Coal washing
Kentucky Blue Grass Mining Co.................	—	Undetermined	Coal washing
Hardy Burlington Mining Co.	—	Undetermined	Coal washing
Darb Fork Coal Co...........	—	Undetermined	Coal washing
Pond Creek Pocahontas Coal Co...................	—	Undetermined	Coal washing

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B.O.D.

SALT RIVER SUB-BASIN

General Description

The Salt River is located entirely in the State of Kentucky and discharges into the Ohio River about 25 miles below Louisville. The sub-basin includes about 2,890 square miles of rolling land, most of which lies in the fertile bluegrass section.

Economic Development

The major economic activities in the sub-basin are agriculture and whiskey distilling. Twenty-four distilleries, most of them small and in rural areas, are located in the sub-basin. They are inactive for the most part during the summer months with their major operations beginning in the late fall and continuing throughout the winter and spring months.

Rainfall and Runoff

The average rainfall in the sub-basin is about 45 inches. While little recorded stream flow data are available, it is known that runoff is rapid during the rainy seasons and that flow along most of the main stream and in the tributaries drops to practically nothing during dry weather periods. The treatment requirements at each source of pollution must be determined on the basis of water quality objectives with the knowledge that little dilution is available during critical periods.

Major River Developments

There is no information to indicate that any major river developments are contemplated which would affect waste treatment requirements in the sub-basin.

Population

The total 1940 population was about 140,000. Of this total, the 1940 population in municipalities which are now listed by the State water pollution control agency as contributing wastes to the streams was about 27,000. This does not include Ft. Knox, which is subject to a wide variation in population and at times may exceed other urban population.

Water Uses

Thirteen public water supplies, serving approximately 24,000 persons, obtain raw water from surface supplies. In addition, Ft. Knox obtains a portion of its supply from surface sources. One municipality in the sub-basin obtains water from a surface supply outside the sub-basin. Ten of the public water supplies are from streams above sources of pollution. The water resources are used for industrial supplies, some of which are taken from natural pools and some from inpoundments. They are also important as a source of water supply for livestock. Swimming, fishing, and other recreational uses of the watercourse are limited because of low water flows during the summer months. Use of natural pools for these recreational activities is limited by wastes from municipalities and industries.

Sources of Pollution

Fifteen municipalities, or other domestic sources, with a combined population of approximately 17,600 served by sewerage systems, contribute wastes to the streams of the sub-basin. Twenty-eight industries, twenty-two of which produce waste with a B. O. D. population equivalent of approximately 95,200 contribute pollution to the watercourses. One of these industries discharges only inorganic wastes. Twenty-four of the twenty-eight industries are whiskey distilleries and create the greater part of the pollution problem of the sub-basin. These distilleries begin their major operations in the late fall and continue through the winter and spring. This seasonal operation tends to reduce the seriousness of the stream pollution problem resulting from their disposal of waste, since their season of inactivity coincides with the months of high temperatures and low stream flow.

Effects of Pollution on Water Uses

In general, pollution damage is limited to short reaches of the stream below points of waste discharge. The recovery of the streams is fairly rapid during periods of normal flow. Recreational uses of the streams are curtailed by pollution, particularly during the periods of low flows.

Treatment Provided

Fifteen municipalities or institutions contribute significant wastes to the streams of the sub-basin. Of these, four, with a combined population served of 3,900, have primary treatment plants; eight, with a combined population of 12,000, have secondary treatment; and three, with a combined population of about 1,800, have no treatment facilities. Of the twenty-eight industrial plants in the sub-basin, only one provides treatment for its wastes. Data concerning treatment provided are listed in Tables C_{16}, D_{16}, and E_{16}.

Treatment Plants Required

Table G_{16} contains summary data relative to treatment plant requirements in the sub-basin. The total amount of pollution is not great and no unusual technical difficulties are involved in providing the required facilities. Table I_{16} lists individual municipal and industrial projects. Three municipalities require new treatment plants, three require replacement of existing plants, and three require enlargements or additions to existing plants. Twenty-seven industrial plants require new waste treatment facilities, and one requires enlargement of or additions to the existing treatment plant. The degree of treatment to be provided must be determined for each source of pollution. Because of the prolonged periods of low stream flows it is expected that a high degree of treatment of municipal sewage and industrial wastes will be required.

Table A_{16}. Sources of pollution, municipal

Municipal-ities*	Sources of pollution (in number of municipalities)	Population served by severage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	0	—	—
Having population data available (Data on pollution load to watercourse incomplete or not available)	15[1]	17,648	Not applicable
Total	15[1]	17,648	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal severage systems. In some instances the estimates are incomplete.

[1] Includes an army post for which no population estimate is given. At times the population at this location exceeds all other municipal population in the sub-basin.

Tabular Data

Tables A_{16} through I_{16} present data relative to stream pollution in the sub-basin.

Table B_{16}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	22	95,225
Producing organic wastes	5	Undetermined
Producing inorganic wastes	1	Not applicable
Producing wastes of undetermined type	0	—
Total	28	—

*Industries having separate outlets and discharging wastes directly to watercourse.

Table C_{16}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipal-ities*	Plants	
Primary	4	4	3,858
Secondary	8**	8	12,000
No treatment	3	—	1,790

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes an army post for which no population estimate is given. At times the population at this location exceeds all other municipal population in the sub-basin.

Table D$_{14}$. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products.	27	1	26	0
Lumber and wood products..	1	0	0	1
Totals..................	28	1	26	1

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E$_{14}$. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	12	4	7	1	8	3	1
Industrial	1	0	1	0	1	0	0

Table F$_{14}$. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	0	—	0	—
1949	0	—	0	—

Table G₁₆. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	3	1,790	27[1]
Enlargement or additions to existing plant	3	3,383	1
Replace existing plant	3	1,735	0
No project required	6[2,3]	10,740	0
Undetermined	0	0	0

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Includes one industry for which the existence of any present treatment has not been determined.

[2] Includes an army post for which no population estimate is given. At times the population at this location exceeds all other municipal population in the sub-basin.

[3] Includes one location listed as undetermined and one listed as unsatisfactory in table E.

Table H₁₆. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	7	28
Abatement ordered	0	0
Plans under preparation	0	0
Final plans approved	2	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	0	0

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_{16} Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Kentucky:			
Harrodsburg..................	2,350	Additions	Final plans approved
Calvert Distilling Co.	800	New plant	—
Old Joe Distilling Co.	1,000	New plant	—
Hoffman Distilling Co.	4,400	New plant	—
Taylorsville................	1,075	Replacement	—
Bloomfield..................	150	New plant	—
Shepherdsville..............	140	New plant	Final plans approved
James B. Beam Distilling Co.	20,000	New plant	—
Associated Distillers, Inc.	—	New plant	—
Ewing Von Allmen Dairy......	75	New plant	—
Double Springs Distillery...	2,150	New plant	—
Nazareth College............	360	Replacement	—
Foster Trading Corp.	16,000	New plant	—
H. McKenna, Inc.	1,900	New plant	—
Kentucky State Women's Prison....................	133	Enlargement	—
Lincoln Institute...........	300	Replacement	—
Waterfill & Frazier Distillery................	—	New plant	—
Jeffersontown...............	900	Additions	—
Nat. Distillers Products Corp.	700	New plant	—
Blair Distillery Co.	—	New plant	—
Dant Distributing Co.	1,500	New plant	—
United Distilleries of America..................	3,500	New plant	—
Hunter-Wilson Distilling Co., Inc.	14,000	New plant	—
Churchill Distilling Co. ...	12,000	New plant	—
Armour Creameries, Inc.	400	Enlargement	—
Associated Kentucky Distilleries Co.	3,900	New plant	—
Old Happy Hollow Distillers, Inc.	700	New plant	—
Bardstown...................	1,500	New plant	—
Grosscurth Distillery, Inc.	2,100	New plant	—
J. T. S. Brown & Sons Company..................	3,100	New plant	—
Willet Distilling Co.	1,100	New plant	—
Heaven Hill Distillery, Inc.	1,900	New plant	—
National Distillers Products Corp.	—	New plant	—
Barton Distilling Co.	—	New plant	—
Geo. T. Stagg Co.	2,300	New plant	—
Brown Wood Preserving Company.:..................	—	New plant	Waste includes phenols
John P. Dant Distributing Company..................	1,700	New plant	—

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B. O. D.

GREEN RIVER SUB-BASIN

General Description

The Green River has its headwaters in northern Tennessee, flows in a northwesterly direction through western Kentucky and enters the Ohio River above Evansville, Ind. The river drains an area of about 9,220 square miles, 380 square miles of which are in Tennessee, and the remainder in Kentucky. Much of the sub-basin is underlain by cavernous limestone deposits. Considerable areas have no well defined watercourses. Drainage in such areas collects in surface pools and disappears either by evaporation or by finding its way to underground streams. Mammoth Cave is located in this sub-basin.

Economic Development

Agriculture is the principal occupation, although much of the sub-basin is too hilly for cultivation. Extensive coal mining operations are conducted in the western part of the sub-basin.

Rainfall and Runoff

Average annual precipitation over the sub-basin varies from 42 to 49 inches. Generally, sufficient flow data are available for the main streams to permit evaluating relations between low flows and treatment requirements. Natural low flows on the main streams are substantial with respect to the amount of waste discharged and are an important consideration in determining treatment requirements. Natural low flows in the lower river indicate that primary treatment of municipal wastes as a minimum, with such added degree of treatment as is required by local conditions, and a comparative treatment of industrial wastes, will maintain a satisfactory water condition in the main stream.

Major River Developments

The Green River has been developed for navigation and the system includes six locks and dams on the Green River and one each on the Barren and Rough Rivers, providing a 4 to 5-1/2 foot navigation channel as far as Mammoth Cave on the Green River, Bowling Green on the Barren, and Hartford on the Rough. Consideration has been given to development of flood control and multiple-purpose reservoirs in the sub-basin by the Corps of Engineers. The authorized flood control plan includes reservoirs on the Green, Rough, Nolin, and Barren Rivers. None of these reservoirs has been constructed and there is no definite information as to when they may be. Flow regulation would have value in improving stream conditions but would have little tangible value in reducing treatment requirements.

Population

The 1940 population of the sub-basin was about 444,400. Of this total, the 1940 population in municipalities which are now listed by the State water pollution control agencies as contributing significant wastes to the streams was about 62,000.

Water Uses

The Green River and its tributaries are considered good fishing streams and are extensively used for recreation by local residents. There are 15 surface water supplies, serving approximately 49,000 persons, at larger municipalities in the sub-basin. In addition, there are several smaller population centers which obtain water from surface sources. Other stream uses include livestock water supply, industrial water supply, bathing and navigation.

Sources of Pollution

Twenty-three municipalities contribute significant wastes to the streams. As indicated by table A 17, there is no estimate of the total amount of municipal waste from these sources. Ten industrial plants discharge wastes to the streams. The data for two of these indicate a B.O.D. population equivalent of 1,310. Industrial waste, not a serious problem in this sub-basin, consists mostly of wastes from meat and dairy plants and acid mine drainage.

Effects of Pollution on Water Uses

Damages of pollution to water uses are rather small and consist mostly of damages to public water supplies and bathing. The required pollution abatement measures for municipalities in the sub-basin present no unusual technical problems. There is a need for study of the effects of acid mine drainage on the streams to determine what measures, if any, should be taken to abate this pollution. While acid mine drainage may cause local nuisances and appreciable damage to smaller tributaries, its effect on the main streams is not serious at this time.

Treatment Provided

Six municipalities, with sewerage systems serving a population of 22,700, provide primary sewage treatment; secondary sewage treatment, serving a combined population of 20,900, is provided by seven municipalities; and ten municipalities, with a combined population of about 7,900 provide no sewage treatment. Of the ten industrial plants discharging wastes to the streams two have treatment facilities, three have undetermined facilities, and five provide no waste treatment.

Treatment Plants Required

Nine municipalities with sewage systems serving a combined population of approximately 7,800 require new waste treatment plants. Two municipalities with a combined sewered population of about 1,200 require enlargements of or additions to existing treatment facilities. Replacements for existing plants are required by three municipalities which have sewerage systems serving a combined population of about 8,400. Three industrial plants require new waste treatment facilities and one plant requires enlargement of or addition to its treatment plant. The requirements for the remaining six industrial plants have not been determined. Summary data concerning treatment plant requirements in the sub-basin are listed in table G_{17}. Table I_{17} lists individual municipal and industrial projects.

Tabular Data

Tables A_{17} through I_{17} present data relative to amount of pollution, treatment provided, adequacy of treatment, requirements for treatment and list of projects required for the sub-basin. Tables G_{17} and I_{17} do not include data concerning eight coal mines which contribute an undetermined amount of pollution to the streams. Generally, the tabular data do not include consideration of small population centers, most of which have no sewer system or substantial water-carried domestic wastes. These population centers may cause minor water pollution problems, principally local in character.

Table A_{17}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	0	--	--
Having population data available (Data on pollution load to watercourse incomplete or not available)	23[1,2]	51,497[1]	Not applicable
Total	23[1 2]	51,497[1]	--

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes data for two communities having no comprehensive public sewerage system, but for which population data are available. These two communities have an estimated combined population of 2,547.

[2] Includes one community for which no estimate of population served is available.

Table B_{17}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	2	1,310
Producing organic wastes	6	Undetermined
Producing inorganic wastes	0	Not applicable
Producing wastes of undetermined type	2	Undetermined
Total	10	—

*Industries having separate outlets and discharging waste directly to watercourse.

Table C_{17}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	6	6	22,650
Secondary	7	8**	20,900
No treatment	10[1]	—	7,947[1]

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes 2 plants serving one community. Also includes one plant for which the population served is unknown.

[1] Includes data for two communities having no comprehensive public sewerage system, but for which population data are available. These two communities have an estimated combined population of 2,547.

Table D_{17}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	8	2	5	1
Leather and leather products....................	1	—	—	1
Undetermined...............	1	—	—	1
Totals....................	10	2	5	3

*Industries having separate outlets and discharging directly to watercourse.

Table E_{17}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satisfactory	Unsatisfactory	Undetermined	Satisfactory	Unsatisfactory	Undetermined
Municipal	14*	9	4	1	11	2	1
Industrial	2	0	1	1	0	0	2

*Includes two treatment plants serving one community.

Table F_{17}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	0	—	0	—
1949	3	13,400*	0	—

*Includes design population for two of the three plants. Data for the third plant are not available.

Table G_{17}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**	Population served by facilities	Number**
New plant	9[1]	7,847[1]	3
Enlargement or additions to existing plant	2	1,200	1
Replace existing plant	3	8,450	0
No project required	9[2]	34,000	0
Undetermined	0	—	6

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] Includes data for two communities having no comprehensive public sewerage system, but which population data are available. These two communities have an estimated combined population of 2,547.

[2] Includes one community with a new treatment plant for which the population served is unknown. Also, includes one municipality which is served by two treatment plants. One small community now having no comprehensive treatment of wastes is listed as requiring no project.

Table H_{17}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	0	9
Abatement ordered	0	1
Plans under preparation	0	0
Final plans approved	3	0
Construction awaiting financing	0	0
Under construction	0	0
Status undetermined	11	0

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I$_{17}$. Project List - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Tennessee:			
Kraft Foods Co., Portland...	180	New plant	—
Tenn. Frozen Foods, Inc., Portland................	1,130	Additions	—
Kentucky:			
Liberty....................	200	New plant	—
Greensburg.................	400	New plant	—
Columbia...................	600	Replacement	—
Morgantown.................	200	New plant	—
Central City...............	3,000	New plant	—
Livermore..................	200	New plant	—
Calhoun....................	200	New plant	—
Tompkinsville..............	1,438	New plant	[1]Final plans approved
Swift & Co., Glasgow........	—	Undetermined	—
Scottsville................	600	Additions	—
Pet Milk Co., Bowling Green	—	Undetermined	—
Elm Grove Dairy, Bowling Green.............	—	Undetermined	—
Field Packing Co., Bowling Green.............	—	Undetermined	—
Gabbard & Raymer, Bowling Green.............	—	Undetermined	—
Caldwell Lace Leather Co., Auburn..................	—	Undetermined	—
Kentucky Animal By-Products (Russellville)............	—	New plant	Abatement ordered
Leitchfield................	300	Replacement	—
Hartford...................	1,100	New plant	—
Evans & Moffett, Hartford	—	New plant	Slaughterhouse
Beaver Dam.................	600	Additions	—
Madisonville...............	7,550	Replacement	Final plans approved
Sebree.....................	1,109	New plant	[1]Final plans approved

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B. O. D.

[1] No comprehensive public sewerage system.

WABASH RIVER SUB-BASIN

General Description

The headwaters of the Wabash River Sub-Basin are in Ohio, near Celina. Part of the original headwater area lies within the Grand Reservoir (Lake St. Marys). The main stream flows from its headwaters in a northwesterly direction into Indiana, then across the upper third of Indiana, then turns south and becomes the border between Indiana and Illinois near Terre Haute, and finally joins the Ohio River above Shawneetown, Ill. The total area of the sub-basin is about 33, 100 square miles, 320 of which are in Ohio, 24, 220 in Indiana, and 8, 560 in Illinois. The principal tributaries are the White River, formed by the East Fork and West Fork, the Little Wabash River, the Patoka River, the Embarrass River, the Vermillion River, and the Tippecanoe River. The northern half and southwestern portions of the sub-basin are flat to gently rolling, with the Wabash lowlands in the extreme southwestern portion. The topography of the southeastern section varies from high flat or rolling uplands to hilly terrain.

Economic Development

Agriculture and industries related to processing of agricultural products are the predominant economic activities in the sub-basin. Other industries in the sub-basin include chemical, fabricated metal, petroleum, coal, textile, ceramic, and building stone. Mineral resources include coal, clay, limestone, gravel, petroleum, and natural gas.

Rainfall and Runoff

The average annual precipitation for the sub-basin is approximately 40 inches, being about 37 inches in the northern section and 43 inches in the southern section. Available stream flow data on the main stem and major tributaries are fairly adequate for the purpose of establishing relationships between stream flow and pollution abatement requirements. Generally, the minimum flows in the main stem are such that provision of reasonable treatment facilities will result in satisfactory stream conditions. In some cases, flows in the tributaries, particularly in the West Fork River below Indianapolis, are such that high degrees of treatment will be required.

Major River Developments

The Wabash River and its tributaries have not been developed for navigation. Some small hydroelectric plants are in operation in the sub-basin. One flood control reservoir, namely Cagles Mill Reservoir on Mill Creek (tributary to the West Fork) is being constructed by the Department of the Army, Corps of Engineers. Other sites have been considered as possible locations for flood control reservoirs in the Ohio River comprehensive flood control plan, and one such reservoir is authorized for construction. There appears to be no immediate prospect that changes in flow conditions in the streams from major river developments will materially affect treatment requirements for pollution abatement.

Population

The 1940 population in the sub-basin was estimated at about 2, 508, 600. The 1940 population in municipalities contributing significant wastes to the streams was about 1, 400, 200. Of this total, 8, 500 resided in Ohio, 204, 600 in Illinois, and 1, 187, 100 in Indiana.

Water Uses

Surface water uses in the sub-basin include domestic, industrial and livestock water supplies, and fishing, bathing and other recreational uses. There are 39 surface water supplies in the sub-basin which serve 47 municipalities with a population of 710, 000. In addition, 5 institutions, with a population of 11, 065, are served by surface water supplies. From the standpoint of population served, most of the surface water supply is withdrawn from the streams at points below sources of pollution. This situation presents conditions which are hazardous in some instances. In other instances, because of the relatively small degree of pollution combined with a long time-distance factor between the source of pollution and the water intake, there is no hazard.

Sources of Pollution

An estimated waste load of about 1, 269, 000 population equivalent from 266 municipalities and connected industries is discharged into the streams of the sub-basin. In addition, 23 municipalities, having a population of about 28,000, discharge an undetermined amount of waste to the streams. Included in the municipal sources of pollution are 23 small communities which, at present, have no comprehensive sewerage system. Fifty industrial plants, not connected to municipal sewerage systems, discharge an estimated waste load of 704,600 population equivalent. One hundred and sixteen industrial plants discharge an undetermined amount of organic waste. Twenty-two plants discharge significant amounts of inorganic waste, six of which also discharge organic waste. Most of the industrial plants listed as sources of pollution are canneries. It is of considerable significance that about 57 percent of the total waste load from municipalities is discharged at two points in the sub-basin, these two locations being Indianapolis and Terre Haute. Also, about 51 percent of the combined total municipal waste load and the organic waste load from the fifty industrial establishments for which estimates of waste load are available is discharged at these two points. Wastes from 9 other municipalities represent 25 percent of the total municipal waste load, so that about 82 percent of the municipal waste load in the Wabash sub-basin is discharged from 11 municipalities and only 18 percent from the remaining 278 municipalities listed as sources of pollution.

Up-to-date information on the pollutional significance of wastes from the coal mining and petroleum industries in the Wabash sub-basin has not been obtained. The Ohio River Pollution Control Survey (published as House Document 266, 78th Congress, 1st Session), which reflected conditions ten years ago, stated that the acid load from coal mines in the sub-basin was 62,542 tons per year. Up to that time an estimated acid waste load of 47,040 tons per year had been removed by sealing of abandoned mines. Further information on the waste load from these industries is desirable in order to evaluate their significance.

Effects of Pollution on Water Uses

The wastes discharged to the streams in the Wabash sub-basin have substantial damaging effects on present and potential water uses. While these damages do not occur on all streams or throughout the length of any particular stream, they do occur in certain stream reaches throughout the sub-basin. Many of the surface water supplies obtain water from streams subject to significant pollution from domestic and industrial sources and many of the water works are obliged to treat water of a higher bacterial count or chemical content than is desirable. The continued delivery of safe water from these plants is a credit to the operators rather than an indication of an acceptable raw water supply. The water pollution control agency in Illinois advises that principal difficulties related to municipal water supplies in that State concern taste problems at a limited number of locations caused by wastes from oil fields. High bacterial counts, great quantities of silt, and industrial wastes are responsible for curtailed utilization of the streams for recreational purposes. In some instances the oxygen content of the stream declines below the limit necessary to support fish life for periods in certain stream reaches and the quality of the water in the more important fishing areas in such that the edible quality of the fish is impaired. The worst conditions occur in the lower portion of the main stem of the Wabash and in the West Fork of the White River.

Treatment Provided

Ninety-nine communities, with a population of some 943,500 persons, are served by 96 secondary treatment plants, and 22 towns, with a population of about 80,400, are served by 23 primary plants. Industrial wastes are given some form of treatment at 131 industries. Seventy-eight of the municipal and 75 of the industrial waste treatment plants are considered adequate for present needs.

Treatment Plants Required

Requirements for pollution abatement in the sub-basin include 164 new treatment plants, 27 enlargements or additions to existing plants, and one replacement, while requirements at one location are undetermined. Many of the sources of pollution listed are responsible only for local nuisances or objectionable pollution in a limited stream reach immediately below the sewer outfall. These sources are included because the nuisance created is of sufficient importance to warrant corrective action. Industrial treatment plant requirements include 59 new plants and 20 enlargements or additions, while requirements at seven locations are undetermined, and no projects are required at 99 locations. In many instances it will be feasible to construct one treatment plant to receive wastes from several sources of pollution, so that the total number of treatment plants to be installed will be reduced. Data summarizing the treatment plant requirements for this sub-basin are contained in Table G_{18}. Individual projects for municipal and industrial sources of pollution are listed in Table I_{18}.

Tabular Data

Tables A_{18} through I_{18} present data related to pollution in the Wabash sub-basin.

Table A_{18}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	266[1]	1,390,757[1]	1,269,076[1]
Having population data available (Data on pollution load to watercourse incomplete or not available)	23[2] [3]	27,980[2]	Not applicable
Total	289	1,418,737	--

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

[1] Includes data for 21 communities having no comprehensive public sewerage system. These communities have an estimated combined population of 13,903.

[2] Includes data for 1 community having no comprehensive public sewerage system. This community has an estimated population of 300.

[3] Includes 1 community for which population data have not been obtained. This community has no comprehensive public sewerage system.

Table B_{18}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	50**	704,576
Producing organic wastes	116	Undetermined
Producing inorganic wastes	22	Not applicable
Producing wastes of undetermined type	3	Undetermined
Total	185[1]	—

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes 6 plants also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus,**.

Table C_{18}.
Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	22	23	80,403
Secondary	99	96	943,459
No treatment	168** [1]	—	394,875**

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

**Includes data for 22 communities having no comprehensive public sewerage system. These communities have an estimated combined population of 14,203.

[1] Also includes 1 community having no comprehensive public sewerage system and for which population data have not been obtained.

Table D_{18}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products.........	125	93	30	2
Textile mill products.................	2	0	2	0
Lumber and wood products............	1	1	0	0
Paper and allied products..........	7	2	5	0
Chemical and allied products..........	15	10	4	1
Products of petroleum and coal.......	8	7	1	0
Leather and leather products.........	1	0	1	0
Fabricated metal products...........	6	4	2	0
Miscellaneous..............	8	5	3	0
Undetermined...............	12	9	2	1
Totals...................	185	131	50	4

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{18}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	119*	78	33	8	90	19	10
Industrial	131	75	48	8	101	20	10

*119 plants serving 121 communities.

Table F_{18}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	5	Undetermined
1947	2	49,200	17	Undetermined
1948	2	6,000	23	Undetermined
1949	2	1,500	35	Undetermined

Table G_{18}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number **[1]	Population served by facilities	Number**[1]
New plant	164[2]	412,119[2]	59
Enlargement or additions to existing plant	27	565,889	20
Replace existing plant	1[3]	1,979	0
No project required	96[4] [5]	438,250[4]	99
Undetermined	1	500	7

*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by other tables. See discussion under "Pollution Prevention Measures Required," Part 1 of the report.

[2] Includes data for 18 communities having no comprehensive public sewerage systems. These communities have an estimated combined population of 12,450.

[3] One municipality now served by two primary treatment plants.

[4] Includes data for 4 communities having no comprehensive public sewerage systems. These communities have an estimated combined population of 1,753.

[5] Also includes one community having no comprehensive public sewerage system and for which population data have not been obtained. Included under "No projects required" are 3 population centers served by one secondary treatment plant and one municipality located partly in the sub-basin which is tributary to a secondary plant listed in another sub-basin.

Table H_{18}. Status of treatment works projects to abate pollution July 1, 1950

Status of project*	Number	
	Municipal	Industrial
No formal action	7	63
Abatement ordered	3	5
Plans under preparation	26	5
Final plans approved	27	1
Construction awaiting financing	1	0
Under construction	6	5
Status undetermined	123	7

*Projects required for pollution abatement may have proceeded through several of the stages indicated but are listed only once at the most advanced stage.

Table I_{18}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Indiana:			
Markle	671	New plant	Population equivalent 5,000
Huntington Packing Co.	—	Undetermined	—
Container Corp. of America	11,500	New plant	—
Wabash	9,653	New plant	—
Logansport	20,177	New plant	—
Schmidt Brewery	277	New plant	City sewer connection possible.
Indiana Rendering Co.	747	New plant	—
Logansport Leathers	2,738	New plant	—
Lafayette	28,798	New plant	—
Lafayette Brewery	1,800	New plant	City sewer connection possible
Alton Boxboard Co.	11,000	New plant	City sewer connection possible
West Lafayette	6,270	New plant	Population equivalent 13,440—including Purdue U.
Attica	3,760	New plant	—
Covington	2,096	New plant	Planning funds applied for (1)
Newport	795	New plant	—
Montezuma	1,366	New plant	—
St. Mary of the Woods	500	Undetermined	—
Valentine Packing Co.	1,966	New plant	—
Terre Haute	62,693	New plant	Population equivalent 353,630 Preliminary plans approved
Commercial Solvents Corp.	167,060	Enlargement	—
Merchants Distilling Co.	5,930	Enlargement	—
Terre Haute Paper Co. Plant No. 2	82,000	New plant	Experimental work
Indiana Wood Preserving Company	1,600	New plant	—
U. S. Penitentiary	2,000	Enlargement	Population equivalent 5,900
Ft. Wayne Paper Co.	69,000	New plant	—
Central Fibre Prod. Co.	27,000	New plant	—
Vincennes	18,228	New plant	Population equivalent 32,600 Preliminary plans approved
New Harmony	1,390	New plant	(1)
Denbo Canning Co.	—	New plant	Lagoon
C. & M. Plating Co.	—	Undetermined	Plating wastes
Roanoke	808	New plant	—
Huntington Fertilizer Co.	900	New plant	—
Ossian	784	New plant	—
Andrews	954	New plant	—
Portland	6,362	New plant	Preliminary plans approved
Montpelier	1,800	New plant	—
Warren	1,388	New plant	—
Van Buren	825	New plant	—
Ridgeville	1,003	New plant	Engineer employed
Albany	1,623	New plant	—
Eaton	1,453	New plant	State loan granted
Gas City	3,488	New plant	Engineer employed
Gas City Canning Co.	1,500	New plant	—
Jaqua Canning Co.	—	New plant	—
Redkey	1,538	New plant	—
Parker	786	New plant	—
Dunkirk	2,942	New plant	Engineer employed

See footnotes at end of table.

Table I18. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
Indiana—Continued			
Upland	900	New plant	—
Midwest Food Packers, Inc.	12,000	New plant	Lagoon
Fairmount	2,328	New plant	—
Jonesboro	1,791	New plant	—
Paranitte Wire & Cable	50	New plant	—
La Fontaine	554	New plant	—
Swayzee	661	New plant	—
Bunker Hill	561	New plant	—
Converse	943	New plant	—
South Whitley	1,118	New plant	—
N. Manchester	3,170	New plant	—
Roann	429	New plant	—
Churubusco	1,122	New plant	—
Weatherhead Corp.	—	New plant	Plating wastes
Columbia City	4,219	New plant	Final plans approved
Silver Lake	471	New plant	—
Walton	710	New plant	—
Camden	590	New plant	—
Smith Dairy	260	Undetermined	—
Delphi	2,213	New plant	—
Galveston	735	New plant	—
Flora	1,468	New plant	Engineer employed
Etna Green	423	New plant	—
Bourbon	1,145	New plant	—
Winamac	1,835	New plant	—
Monticello	3,153	New plant	Under construction
Pierceton	895	New plant	—
Lake City Electroplating	—	New plant	Plating wastes—City sewer connection possible
Warsaw	6,378	New plant	Under construction
Crystal Dairy	—	New plant	City sewer connection possible
Winona Lake	743	Enlargement	Engineer employed
Mentone	731	New plant	—
Akron	990	New plant	—
Rochester	3,835	Enlargement	—
Culver	1,605	New plant	Engineer employed
Kewana	701	New plant	—
Medaryville	703	New plant	—
Francisville	804	New plant	—
Walcott	736	New plant	—
Monon	1,262	New plant	Order issued
Royal Center	865	New plant	Population equivalent 2,500
Chalmers	475	New plant	—
Brookston	826	New plant	—
Greentown	1,060	New plant	—
Continental Steel Corp.	—	Additions	—
Windfall	835	New plant	—
Miller Packing Co.	—	New plant	—
Frozen Dairy	150	New plant	—
Clarks Hill	381	New plant	(1)
Rossville	627	New plant	—
Battle Ground	506	New plant	(1)
Alt Woolen Mills	—	New plant	—
Otterbein	570	New plant	—
Oxford	863	New plant	—

See footnotes at end of table.

Table I_{18}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Indiana--Continued			
Fowler (Part)	1,903	New plant	Final plans approved--Part to Kankakee River
Boswell	877	New plant	—
Williamsport	1,222	New plant	—
West Labanon	581	New plant	—
Cayuga	1,126	New plant	—
New Richmond	368	New plant	(1)
Veedersburg	1,781	New plant	Order issued
Hillsboro	516	New plant	(1)
Kirklin	712	New plant	—
Mid States Steel & Wire Company	—	Enlargement	Order issued
Crawfordsville	11,089	Enlargement	—
Thorntown	1,226	New plant	Final plans approved
Presser Packing Co.	349	New plant	—
Colfax	717	New plant	—
Linden	580	New plant	(1)
Dana	845	New plant	—
Mecca	1,000	New plant	—
Roachdale	736	New plant	—
Seelyville	807	New plant	(1)
Glenn Home	138	Additions	—
Pfizier Chemical Corp.	12,000	Undetermined	—
Vigo Co. Home	135	Additions	—
Hymera	1,298	New plant	(1)
Carlisle	874	New plant	Preliminary plans approved (1)
Farmersburg	1,005	New plant	—
Star Packing Co.	—	New plant	—
Shelburn	1,606	New plant	—
Sullivan	5,077	Enlargement	Preliminary plans approved
Petersburg	3,075	Additions	—
Hilltop Packing Co.	346	New plant	—
Winslow	1,382	New plant	—
Ferdinand	990	New plant	—
Huntingburg	3,816	New plant	Final plans approved
Indiana Produce Co.	—	New plant	—
Gibson Frozen Food Corp.	35	New plant	—
Hitch Bros.	180	New plant	—
Owensville	1,188	New plant	—
Farmland	914	New plant	Final plans approved (1)
Indiana Steel & Wire Co.	—	New plant	—
Muncie	49,720	Enlargement	Engineer employed
Warner Gear Plant (Plant No. 3)	540	New plant	Plant studies under way
Newhouse Canning Co.	—	Enlargement	Lagoon
Beverage Paper Co.	30,000	New plant	—
Indianapolis Bleaching Company	—	New plant	—
Holliday Steel Co.	—	Undetermined	—
Armour & Company	—	New plant	—
Liquid Sugars, Inc.	—	Undetermined	—

See footnotes at end of table.

Table I_{18}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Indiana—Continued			
Citizens Gas & Coke Utility	4,200	New plant	Also taste and odor removals
Indianapolis	386,972	Enlargement	Final plans approved
Anderson	41,572	Enlargement	Order issued
Chesterfield	581	New plant	Financing (1)
Foland Canning Co.	—	New plant	—
Martinsville	5,009	New plant	Final plans approved
Gosport	729	New plant	Final plans approved (1)
Spencer	2,375	New plant	Preliminary plans approved
Worthington	1,729	New plant	—
Bloomfield Woolen Mills	250	New plant	—
Bloomfield	2,270	Enlargement	Engineer employed
Graham Farm Cheese Plant	—	New plant	—
Parker	786	New plant	—
Gaston	677	New plant	—
Alexandria	4,801	New plant	Final plans approved
Summitville	991	New plant	Engineer employed
Johns-Manville Co.	---	New plant	--
Orestes	412	New plant	(1)
Omega Packing Co.	—	New plant	—
Cicero	943	New plant	—
Sheridan	1,720	New plant	Under construction
Sheridan Packing Co.	—	Enlargement	—
Arcadia	968	New plant	—
Foland Canning Co.	—	New plant	—
Davis Dairy Farms	735	New plant	—
Lapel	1,146	New plant	Engineer employed
Westfield	709	New plant	—
Carmel	771	New plant	—
Indiana Blind School	150	Additions	—
Middletown	1,520	New plant	—
Indiana State Reformatory	2,000	Enlargement	Final plans approved
Ingalls Canning Co.	—	Additions	—
W. H. Roberts Dairy	500	New plant	City sewer connection possible
Fortville	1,463	New plant	Final plans approved
Lawrence	1,087	New plant	—
Sheet Steel Galv. Corp.	—	Enlargement	—
Zionsville	1,314	New plant	—
Clermont	465	New plant	—
Speedway City	2,325	New plant	Final plans approved
Republic Creosoting Co.	—	Additions	—
Rock Island Refinery Co.	4,350	Additions	Also inorganic wastes
C.C.C. & St. L. R.R. Shops	—	New plant	City sewer connection possible
Beech Grove	3,907	Enlargement	Engineer employed
Greenwood	2,499	New plant	Engineer employed—Planning loan applied for
Pittsboro	510	New plant	Final plans approved (1)
Brownsburg	1,136	New plant	—
Plainfield	1,811	New plant	—
Mooresville	1,979	Replacement	—
Morgantown	724	New plant	Final plans approved

See footnotes at end of table.

Table I_{18}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Indiana--Continued			
Bloomington Packing Co.	5,000	New plant	—
Elletsville	863	New plant	—
Hanks Bros. Locker Plant	—	New plant	—
Greencastle	4,872	Enlargement	Under construction
North Salem	511	New plant	—
Jamestown	583	New plant	—
Indiana State Farm	1,300	Enlargement	Final plans approved
Kehoe Preserving Co.	—	New plant	—
Jasonville	3,418	Enlargement	Add final tank
Odon	958	New plant	Final plans approved (1)
Dearmin Meat Co.	800	New plant	—
Vincennes Packing Co. (Plainville)	33,000	New plant	—
Bicknell	5,110	New plant	—
Washington	9,312	New plant	Under construction
Shoals	1,031	New plant	Planning loan applied for
Columbus	11,738	New plant	Final plans approved
Seymour	8,620	New plant	—
Morgan Packing Co. (Brownstown)	23,000	New plant	—
Brownstown	1,860	New plant	Engineer employed
New Palestine Canning Co.	—	New plant	Lagoon
New Palestine	448	New plant	—
Julietta Hospital	800	Enlargement	—
Franklin	6,264	Enlargement	—
Ingersoll Steel & Disc. Company	250	New plant	—
Rose City Packing Co.	5,558	New plant	—
New Castle	17,670	Enlargement	—
Knightstown	2,323	New plant	—
Carthage	937	New plant	—
Container Corp. of America	14,750	Enlargement	—
Morristown	665	New plant	—
Gwynneville	219	New plant	—
Shelbyville	10,971	New plant	Final plans approved
Bausbeck Fertilizer Co.	2,640	Additions	—
Morgan Packing Co. (Edinburg)	—	Enlargement	—
Spiceland	645	New plant	—
Shirley	952	New plant	State loan granted
Mays Packing Co.	—	Additions	—
St. Paul	695	New plant	—
Lewisville	531	New plant	(1)
Glenwood	338	New plant	—
Rushville Canning Co.	—	Enlargement	—
Glenwood Canning Co.	—	Enlargement	—
Hope	1,046	New plant	—
Stadler Packing Co.	—	New plant	—
Greensburg	6,065	Enlargement	Engineer employed
Crothersville	1,169	New plant	—
Vernon	413	New plant	—
Morgan Packing Co. (Austin)	120,000	New plant	Order issued
Austin	650	New plant	—
Scottsburg	2,189	Enlargement	—

See footnotes at end of table.

Table I_{18}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950--Continued

Name	Population served**	Project requirements	Remarks
Indiana--Continued			
Morgan Packing Co. (Scottsburg)	44,000	New plant	Lagoon
Bedford	12,517	New plant	Final plans approved
Oolitic	1,186	New plant	—
Fluck Cut Stone Co.	—	New plant	—
Indiana Creosoting Co.	—	Additions	Taste and odor
Loogootee	2,325	New plant	Engineer employed
Orleans	1,428	Enlargement	—
Paoli	2,218	New plant	
French Lick	2,042	New plant	Engineer employed
West Baden	949	Combined with French Lick	Common sewer with French Lick
Illinois:			
Hutsonville	100	New plant	Final plans approved
Mt. Carmel	6,000	New plant	Preliminary report approved
Paxton	2,000	New plant	—
Catlin	400	Additions	—
Westville	—	New plant	Final plans approved
Hegeler Zinc Co.	—	Additions	—
Georgetown	3,000	New plant	—
Velsicol Corp.	—	Undetermined	—
Ohio Oil Refinery	—	Additions	Improvement under construction
Palestine	1,500	New plant	Final plans approved
Lawrenceville	6,000	New plant	Final plans approved
Texas Refinery	—	Additions	Improvement under construction
Bridgeport	1,500	New plant	Final plans under preparation
Neoga	500	New plant	Final plans approved—Contract let.
Carmi	5,000	New plant	Under construction
Olney	7,000	Enlargement	Final plans approved
Albion	1,800	Enlargement	Final plans approved
Villa Grove	—	New plant	Final plans approved
Ohio:			
Ft. Recovery	1,120	New plant	Final plans approved
Equity Dairies, Inc.	2,200	New plant	Final plans approved
St. Henry	300	New plant	(1)
Beckman & Gast	—	New plant	—

* The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

** Amount of industrial organic waste is reported in terms of population equivalent as measured by B.O.D.

(1) No comprehensive public sewerage system.

CUMBERLAND RIVER SUB-BASIN

General Description

The Cumberland River has its headwaters in southeastern Kentucky, flows in a southwesterly direction into Tennessee, then in a westerly direction across northwestern Tennessee, and, finally, re-enters Kentucky and discharges into the Ohio River about 15 miles above Paducah. The area of the sub-basin is about 17, 720 square miles, 7, 025 square miles in Kentucky and the remainder in Tennessee. The topography varies from mountainous, in the upper part of the sub-basin, to rolling plateau in the lower part.

Economic Development

Economic activities in the sub-basin include agriculture, mining, and manufacturing. Manufactured products include food products, textiles, chemicals, pulp and paper, cement, brick, lumber, steel fabrications, furniture, and other items. Agriculture ranks first from the standpoint of population, but manufacturing is first from the standpoint of the value of the products.

Rainfall and Runoff

The normal precipitation varies from about 54 inches per year in the upper portion of the sub-basin to about 44 inches in the lower river area. Flow data from numerous stream gaging stations with varying periods of operation are available. Three flood control and power reservoirs, two completed and one under construction, are located above the major sources of pollution on the main stem. Low stream flows are governed by regulated discharge from these reservoirs. Flows in the upper headwater and smaller tributary streams drop to practically zero during prolonged dry periods.

Major River Developments

As mentioned above, two large power development and flood control reservoirs have been constructed in the sub-basin by the Corps of Engineers. Another, Wolf Creek Reservoir, is located on the main stem a few miles above Burkesville, in Kentucky, and the pool will extend to the upper end of the main stem. This reservoir is under construction and final contracts for power features have been let. Dale Hollow Dam is located on the Obey River near its mouth about three miles east of Celina, Tenn. Center Hill Dam is located on Caney Fork, southeast of Carthage, Tenn. All of these reservoirs provide minimum pools which are valuable recreation areas. These reservoirs are located above major sources of pollution on the main stem and the regulated discharges would improve low-flow conditions in the lower river. Further study of the effects of this regulation, particularly with respect to reduction in regulated flows during off-peak power demands, is required. Three other reservoirs are in the comprehensive plan for the development of the Cumberland River Sub-Basin. These are located on tributaries in the lower part of the sub-basin. They will have no significant effect on pollution abatement requirements. The Cumberland River is considered to be a navigable stream and improvements for navigation include locks and dams to provide a 6-foot navigation depth from the mouth to mile 331. The lock and dam at mile 487 which provided a 4-foot depth to Burnside, mile 516, will be in the pool of Wolf Creek Reservoir. Cheatham Lock and Dam is now under construction. This is the first step in modernization of the lower Cumberland River navigation system to provide a minimum navigation channel of nine feet.

Population

The 1940 population in the sub-basin is estimated to have been about 1, 129, 000. Of this total the 1940 population in 48 municipalities which are now listed by the State water pollution control agencies as contributing significant wastes to the watercourses is estimated at 330, 500.

Water Uses

The waters in the sub-basin are widely used for recreational purposes, particularly in the conservation pools of multiple-purpose reservoirs. Sport fishing is particularly popular and visitors travel for hundreds of miles to the area for this purpose. Many commercial recreational areas have been developed and these will be increased with the impoundment of Wolf Creek Reservoir. Twenty-seven municipal water supplies, obtaining water from watercourses, provide water for 30 minicipalities (including institutions) and serve approximately 301, 500 persons. Other water uses include industrial water supply, livestock water supply, hydroelectric power, and navigation.

Sources of Pollution

Twenty-eight municipal sewerage systems discharge an estimated wasteload of about 228,200 population equivalent to the streams. Twenty municipal systems, serving about 66,800 persons, discharge an undetermined amount of waste. Twenty-eight industrial plants discharge an estimated waste load of 309,600 in terms of population equivalent. In addition, two plants discharge an undetermined waste load and 13 plants discharge waste loads not measured in terms of population equivalent. About 95 percent of the total organic waste load is discharged in the lower half of the sub-basin (below entrance of Caney Fork) and most of this load is discharged directly to the main stem and one tributary.

Determination of waste treatment requirements in this portion of the sub-basin must take into consideration operation practices at the above mentioned reservoirs and contemplated future developments. Consultation between interested Federal and State agencies will be required in order to develop optimum pollution abatement benefits from low flow regulation compatible with other uses.

Acid mine drainage is discharged to the watercourses in the upper part of the sub-basin. The total acid load prior to mine sealing was estimated to be 264,800 tons per year in 1940. The residual acid load after reduction by mine sealing was estimated to be 196,000 tons per year. No estimate of the present acid load is available but it is believed that the load is greater than it was in 1940. Further consideration should be given to the effects of this waste and remedial measures required.

Effects of Pollution on Water Uses

The most significant pollution effects occurring in the sub-basin are observed on the main stem downstream from Nashville to Clarksville and result from the pollution contributed to the stream by the sources in the Nashville vicinity. Nuisance conditions prevail in this section of the Cumberland River during periods of low stream flow. On occasions, all of the fish in the river between Nashville and Clarksville have been killed. At times the dissolved oxygen content of the stream is very low, foul odors are produced, and extensive sludge beds are found along the bed of the stream. The Harpeth River is grossly polluted below Franklin. Considerable pollution is discharged into the Red River near its mouth by the City of Clarksville and its industries. Generally, wastes from other municipalities and industries are discharged at isolated points along the streams and result in only localized damage.

Treatment Provided

Of the 48 municipalities discharging significant amounts of wastes to the streams of the sub-basin, 13 provide primary sewage treatment, serving a combined population of about 25,800; 14 provide secondary treatment for a population of about 65,000; and 21, with a combined population of about 160,300, provide no sewage treatment. Dickson, Tenn., has two sewerage systems. One, serving a population of about 1,700, contributes to the Tennessee River through a tributary to the Duck River; the other, serving a population of about 1,700, contributes to the Cumberland River through a tributary to the Harpeth River. Data for the latter system are included in this section. Thirteen of the 42 industrial plants provide waste treatment, while the treatment status for two is undetermined. It has been estimated that these industrial waste treatment plants reduce the organic pollution load less than one percent. However, considerable progress has been made by one industry, through recovery works and operation improvements, which is not reflected in the estimate of waste reduction. Data concerning treatment provided in the sub-basin are listed in tables C_{19}, D_{19} and E_{19}.

Treatment Plants Required

Table G_{19} contains summary data concerning waste treatment plant requirements for the sub-basin. Table I_{19} lists individual municipal and industrial projects. All of the 21 municipalities which now have no treatment facilities require new waste treatment plants. Six municipalities require enlargements of or additions to existing treatment plants. Replacement of the existing plants in 7 municipalities is required. Of the 42 industrial plants discharging wastes to the streams of the sub-basin, 21 require new treatment facilities two require enlargements of or addition to existing facilities, 5 require replacement of existing facilities, and the requirements for 8 have not been determined.

Tabular Data

Tables A_{19} through I_{19} present data on matters related to stream pollution. In addition to the sources of pollution listed, there are minor sources of pollution from small unsewered communities. No comprehensive evaluation of the acid mine drainage problem is available at this time.

Table A_{19}. Sources of pollution, municipal

Municipalities*	Sources of pollution (in number of municipalities)	Population served by sewerage system	Amount of pollution discharged to watercourse (in terms of equivalent number of people)**
Having data on pollution load discharged to watercourse	28	184,355	228,235
Having population data available (Data on pollution load to watercourse incomplete or not available)	20	66,828	Not applicable
Total	48	251,183	—

*Includes incorporated or unincorporated municipalities, other legal bodies such as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes estimates of industrial wastes discharged into municipal sewerage systems. In some instances the estimates are incomplete.

Table B_{19}. Sources of pollution, industrial*

Industries	Sources of pollution (in number of plants)	Amount of pollution discharged to watercourse (in terms of equivalent number of people)
Producing organic wastes	28**	309,625
Producing organic wastes	1	Undetermined
Producing inorganic wastes	13	Not applicable
Producing wastes of undetermined type	1	Undetermined
Total	42[1]	--

*Industries having separate outlets and discharging wastes directly to watercourse.

**Includes one plant also producing inorganic wastes.

[1] Total adjusted to correct for duplication noted in footnote marked thus,**.

Table C_{19}. Existing treatment facilities, municipal

Degree of treatment provided	Number		Population served
	Municipalities*	Plants	
Primary	13	13	25,775
Secondary	14	14	65,130
No treatment	21	--	160,278

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

Table D_{19}. Existing treatment facilities, industrial*

Type industry	Number of plants	Number of industrial plants having:		
		Treatment facilities	No treatment facilities	Undetermined facilities
Food and kindred products..	19	5	14	0
Textile mill products......	3	1	2	0
Paper and allied products..	1	0	1	0
Chemical and allied products..................	6	3	3	0
Products of petroleum and coal......................	4	1	3	0
Mining industries...........	4	2	0	2
Undetermined...............	2	1	1	0
Miscellaneous..............	3	0	3	0
Totals....................	42	13	27	2

*Industries having separate outlets and discharging wastes directly to watercourse.

Table E_{19}. Adequacy of existing treatment facilities

Existing treatment facilities	Number	Adequacy with relation to:					
		Capacity			Operation		
		Satis-factory	Unsatis-factory	Unde-termined	Satis-factory	Unsatis-factory	Unde-termined
Municipal	27	14	12	1	19	7	1
Industrial	13	4	4	5	5	2	6

Table F_{19}. Progress in pollution abatement

Year	Municipal		Industrial	
	Plants completed	Design population	Plants completed	Amount of waste treated (in terms of equivalent number of people)
1946	0	—	0	—
1947	0	—	0	—
1948	0	—	0	—
1949	1	3,000	3	2,620

Table G_{19}. Requirements for municipal and industrial waste treatment plants*

Requirements	Municipal		Industrial
	Number**[1]	Population served by facilities	Number**[1]
New plant	21	160,278	21
Enlargement or additions to existing plant	6	19,770	2
Replace existing plant	7	15,675	5
No project required	14	55,460	6
Undetermined	0	—	8

*The needs set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**The numerical values representing requirements are based on the number of municipal and industrial sources of pollution. These values may differ considerably from the actual number of projects required because of the possibility of multiple sources of pollution becoming tributary to one treatment plant, or because of multiple treatment plants being required at one location.

[1] The listing of requirements in this table is not necessarily in accordance with requirements which may be indicated by other tables. See dicussion under "Pollution Prevention Measures Required."

Table H_{19}. Status of treatment works projects to abate pollution, July 1, 1950

Status of project	Number	
	Municipal	Industrial
No formal action	11	23
Abatement ordered	0	1
Plans under preparation	7	4
Final plans approved	1	0
Construction awaiting financing	5*	6**
Under construction	0	1
Status undetermined	10	1

*Includes one institution which will connect to Nashville treatment plant.

**Includes 5 industries which will connect to the Nashville treatment plant, and one industry which will connect to the Watertown treatment plant. These treatment plants are now awaiting financing.

Table I_{19}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950

Name	Population served**	Project requirements	Remarks
Kentucky:			
Lynch	8,000	New plant	—
Benham	450	New plant	—
Cumberland	1,100	New plant	—
Closplint	400	New plant	—
Cornett-Lewis Coal Co.	—	Replacement	Coal washing
Harlan	4,500	New plant	Final plans approved
Loyall	250	Replacement	—
Kentucky Cardinal Coal Co.	—	Undetermined	Coal washing
Pineville	2,500	New plant	—
Fayette-Jellico Coal Co.	—	Undetermined	—
Barbourville	1,300	New plant	Plans under preparation
Williamsburg	900	New plant	—
Cumberland Falls	100	New plant	—
Corbin	7,800	Replacement	—
Burnside Veneer Co.	—	New plant	—
Somerset Refining Co.	200	Enlargement	Oil producers
Somerset Creamery Co.	300	Replacement	—
Monticello	1,750	Additions	—
Pennyroyal Packing Co.	500	New plant	—
Cadiz	1,228	New plant	Plans under preparation
Eddyville	1,400	New plant	—
Eddyville State. Penitentiary	1,800	New plant	—
Freedonia Cheese Co.	100	New plant	—
Tennessee:			
E.I. Dupont & Co.	78,000	New plant	Rayon Manufacturing plant — Plans under preparation
Madison College	300	Replacement	Plans under preparation
Nashville	117,000	New plant	Construction awaiting financing
Armour Fertilizer Co.	—	Undetermined	—
A.J. Brown Co.	80	Replacement	Rendering plant
W.G. Bush & Co.	200	New plant	(1)
Jacobs Packing Co.	10,000	New plant	(1)
Cumberland R. Sand Co.	—	Undetermined	—
Federal Chemical Co.	—	Undetermined	—
Victor Chemical Co.	—	Undetermined	—
Nashville Gas Co.	1,300	New plant	Phenol waste[1]
Davidson Chemical Co.	—	Undetermined	—
Neuhoff Packing Co.	135,000	New plant	(1)
Boys Vocational school	400	New plant	—
Davidson Co. Tuberculosis Hospital	100	New plant	—
State Penitentiary	2,200	New plant	(1)
Clarksville Pure Milk Co.	10	New plant	—
Clarksville	7,700	New plant	47,700 population equivalent to stream—Construction awaiting financing
Murfreesboro	6,400	Enlargement	—
Carnation Co. (Murfreesboro)	4,800	New plant	—
Woodbury	970	Additions	Construction awaiting financing
Nolansville Creamery	150	New plant	—
Baltz Bro. Packing Co.	120	New plant	—
Southern Oil Service	4,000	New plant	—
The Mead Corp.	60,000	New plant	Pulp and paper manufacturing — Plans under preparation

See footnotes at end of table.

Table I_{19}. Project list - municipalities and industries requiring improvements for abatement of pollution*, July 1, 1950—Continued

Name	Population served**	Project requirements	Remarks
Tennessee—Continued			
Teas Extract Co.	3,300	New plant	Chemical industry
Franklin	4,400	Replacement	Plans under preparation
Dickson (part)	1,700	Replacement	1700 to Duck River and 1700 Cumberland River
Springfield	4,700	Enlargement	Plans under preparation
Springfield Woolen Mills	3,000	New plant	Plans under preparation
Carthage	1,500	New plant	—
Pruden Coal Co.	—	Undetermined	—
Jellico	1,200	New plant	—
Oneida	525	Replacement	—
Sparta	2,200	Additions	—
Carnation Co. (Sparta)	500	New plant	—
McMinnville	1,700	New plant	—
Helpy Selfy Laundry	45	New plant	—
Quality Hosiery Mills	—	New plant	—
Cookeville	4,800	New plant	Plans under preparation
Watertown	200	Replacement	Construction awaiting financing
Carnation Co. (Watertown)	650	New plant	—
Cudahy Co.	850	Enlargement	Abatement ordered
Lebanon Woolen Mills	1,500	Replacement	Under construction
Gallatin	3,750	Enlargement	Plans under preparation
Kraft Foods Co. (Gallatin)	3,800	New plant	Plans under preparation
W. E. Stephens Co.	200	Replacement	([2])

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*The needs as set forth in this table are based on presently available information. However, future studies and evaluations may result in some changes in these requirements.

**Amount of industrial organic waste is reported in terms of population equivalent as measured by B.O.D.

[1] To be connected to proposed Nashville treatment plant.

[2] To be connected to proposed Watertown treatment plant.